

Sea Basing Platforms For The 21st Century- An Evaluation Of Maritime Prepositioning Force (Future) [MPF(F)] And The Mobile Offshore Base (MOB) To Perform Sea Basing

CSC 2004

Subject Area National Military Strategy

Table of Contents

EXECUTIVE SUMMARY	3
INTRODUCTION: WHY SEA BASING IS REQUIRED FOR FUTURE OPERATIONS	5
POLITICAL ISSUES	5
THREAT TO FORCES	7
DENIAL	9
ANTI-ACCESS CONCERNS AND SOLUTIONS FROM U.S. MILITARY LEADERS	10
SEA BASING CONCEPTS	12
EARLY SEA BASING CONCEPTS.....	14
EXAMPLES OF SEA BASING	17
SERVICE SQUADRON TEN	17
KOREAN WAR	19
VIETNAM WAR	21
OPERATION DESERT SHIELD/DESERT STORM	23
THE PLATFORMS FOR SEA BASING	26
TODAY’S MARITIME PREPOSITIONING FORCE	26
MARITIME PREPOSITIONING FORCE (FUTURE)	27
CENTER OF NAVAL ANALYSIS MPF(F) CONCEPTS OF OPERATIONS.....	28
BAND, LAVIS & ASSOCIATES MPF(F) DESIGNS	31
NAVAL SEA SYSTEMS COMMAND AND ADVANCED MARINE ENTERPRISES DESIGNS	35
THE MOBILE OFFSHORE BASE.....	39
MOB PLATFORM CONCEPTS	41
COMPARATIVE ANALYSIS	46
PRIMACY OF THE SEA BASE.....	46
REDUCING LOGISTICS DEMAND	49
IN-STRIDE SUSTAINMENT	52
ADAPTIVE RESPONSE & INTEROPERABILITY	54
FORCE CLOSURE AND RECONSTITUTION AT SEA	56
OTHER CONSIDERATIONS	59
MOBILITY	59
FORCE PROTECTION/VULNERABILITY	60

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2004		2. REPORT TYPE		3. DATES COVERED 00-00-2004 to 00-00-2004	
4. TITLE AND SUBTITLE Sea Basing Platforms For The 21st Century- An Evaluation Of Maritime Prepositioning Force (Future) [MPF(F)] And The Mobile Offshore Base (MOB) To Perform Sea Basing				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Marine Corps War College,Marines Corps University,Marines Corps Combat Development Command,Quantico,VA,22134-5067				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 68	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

COST AND CONSTRUCTABILITY	60
CONCLUSION	62
BIBLIOGRAPHY	65

EXECUTIVE SUMMARY

Title: SEA BASING PLATFORMS FOR THE 21ST CENTURY- AN EVALUATION OF MARITIME PREPOSITIONING FORCE (FUTURE) [MPF(F)] AND THE MOBILE OFFSHORE BASE (MOB) TO PERFORM SEA BASING

Author: LCDR Eric W. Covington, United States Navy

Thesis: The Navy and Marine Corps must choose a sea basing platform concept that will enable the tenets of “Seabased Logistics”. The Maritime Prepositioning Force (Future) [MPF(F)] concept replaces the existing prepositioning fleet with modern vessels adapted for sea basing needs. The Mobile Offshore Base (MOB) concept enables at-sea arrival and assembly, and integration of operational forces at sea through the use of strategic airlift. Comparing the capabilities of each concept to the tenets of “Seabased Logistics” singles out the sea base concept that is suitable for further development.

Discussion: The lack of assured access to host nation supported overseas bases, due to political issues, anti-access and area denial weapons, requires U.S. military forces to employ new methods to project direct and decisive power. Military and political leaders, worried about reluctance of foreign governments to allow U.S. military forces to use their territory for military operations, are looking for substitutes to replace the loss of those facilities. Sea Basing forms the foundation of generating overwhelming offensive and defensive joint power from the sea. Sea Basing maintains command-and-control, delivers integrated fires, projects and sustains maneuver forces from over the horizon. Naval expeditionary logistics have provided sustainment, from over the horizon, from World War II to Operation DESERT SHIELD/DESERT STORM. Maritime Prepositioning Force (Future) [MPF(F)] and Mobile Offshore Base (MOB) are competing sea base platform concepts that will enable Sea Basing by providing indefinite sustainment, reducing the footprint ashore, selective offload, adaptive response, interoperability, and force closure.

Conclusion(s) or Recommendation(s): MPF(F) concept is the best platform for Sea Basing. The MPF(F) sea base enables the tenets of “Seabased Logistics” by protecting the primacy of the sea base, reducing the footprint ashore, employing selective offload of equipment and supplies, and providing adaptive response and interoperability with other vessels and transport vehicles. The major benefit of the MOB is the ability to receive, assemble, and reconstitute operational forces at sea using strategic lift aircraft. This capability eliminates the requirement for host nation supported airfields and seaports. However, the MOB is too costly and too vulnerable to be considered a credible sea base for decisive campaigns. Lastly, Sea Basing requires the use of a vertical lift aircraft capable of transporting loads of 20 tons or greater. The delivery of tanks and ISO containers to the shore relies on overt and timely mine sweeping and clearing operations, which deny swift ship-to-objective maneuver.

(This page intentionally left blank.)

INTRODUCTION: WHY SEA BASING IS REQUIRED FOR FUTURE OPERATIONS

Numerous military base closures have consolidated U.S. military firepower into large military installations mostly located within the Western Hemisphere. Military planners face the same problems that confronted planners at the beginning of World War II. How does the U.S. project its immense military and economic power across the Atlantic and Pacific oceans without the use of numerous intervening bases? Assured access to foreign land bases, airfields, and seaports has been the linchpin for conducting forward operations. As U.S. influence increases around the world, so do the number of nations seeking to impede U.S. dominance. U.S. forces can no longer assume access to overseas bases to key regions, which makes current missions more difficult. The lack of access to overseas bases is due three factors:

- political issues
- threat to forces
- denial

Political Issues

Diverging political interests between the U.S. and a host nation may lead to constrained or denied use of overseas facilities. More nations seek to leverage or alter U.S. policy by selectively extending and retracting access to facilities within their borders. In his article “Base Access Constraints and Crisis Response”, author Adam B. Siegel states, “Control over the access and use of

bases provides host countries with a means of political leverage and a means to signal discontent over some aspect of U.S. policy.”¹ The U.S. did not operate B-52 aircraft from the Philippines during the Vietnam War due to concerns over Filipino sensitivities.²

U.S. forces can no longer automatically rely on European backing for U.S. military operations. In 1964, the U.S., without approval, moved a transport squadron through Spanish air space in order to support operations in the eastern Congo. In retaliation for not observing Spain’s sovereignty, Spain refused to allow the aircraft to return through Spanish airspace. In 1999, Italy, displeased over perceived slights with regards to its role in Operation ALLIED FORCE, denied U.S. Air Force (USAF) F-117 stealth aircraft access to Aviano Air Base. Also during Operation ALLIED FORCE, France refused to allow armed bombers flying from Fairford, England to over fly its territory enroute to their Balkan targets.³ Greece refused to allow the alliance’s combat forces to fly over its territory or to use its bases, although it did provide logistical support and allow humanitarian over flight. Greece also denied the Marine Corps use of a port of an MPF operation because the facility the Marine Corps requested handled one-third of Greek international trade. During Operations DESERT SHIELD/DESERT STORM and IRAQI FREEDOM, France and Germany were reluctant to support U.S. policy over Iraqi. In Britain, it is possible that a Labour government, radically opposed to the U.S. national security issues in the Middle East, could deny the U.S. forces access to Diego Garcia, a British Protectorate and an important intermediate staging base for operations in the Persian Gulf.

¹ Adam B. Siegel, “Base Access Constraints and Crisis Response”, *AIRPOWER Journal*, Spring 1996, 3.

² Katherine Watkins Webb, “Are Overseas Bases Worth the Bucks? An Approach to Assessing Operational Value and an Application to the Philippines” (Ph.D. diss., RAND Graduate Institute, 1988), 6.

³ David A. Shlapak, John Stillion, Olga Oliker, and Tanya Charlick-Paley, *A Global Strategy for the U.S. Air Force*, (Arlington: RAND, 2002), 10.

The use of land bases and air space require extensive negotiations. Navy aircraft, launched from aircraft carriers, carried the majority of air campaign in the Middle East, while Department of Defense (DoD) officials negotiated for USAF basing rights in Tajikistan, Kazakhstan, and Kyrgyzstan. There are examples of the U.S. government using loans and grants in exchange for access to foreign bases and air space by U.S. forces. In 2004, U.S. officials promised Turkey \$30 billion in grants and loan guarantees in exchange for access to its interior airfields.⁴

Threat to Forces

Future adversaries seek the capability to restrict or deny the U.S. military's ability to project military power overseas.⁵ New weapons development can deny or disrupt U.S. entrance into a theater of operations. Military and commercial space capabilities, over-the-horizon radars, and low-observable unmanned aerial vehicles could give potential adversaries the ability to perform wide area surveillance and tracking of U.S. forces. Enemies of the United States will have either the economic power to purchase these weapons or the industrial capability to manufacture these weapons within their own borders.

Sophisticated mines deny and disrupt U.S. operations into the littorals. Mines have caused more damage to U.S. naval ships than any other weapon since World War II. Fourteen U.S. naval ships were either sunk or damaged by sea mines since World War II.⁶ Sea mines represent an asymmetric maritime capability that adversaries could employ in littoral warfare. Mines are covert and easily deployed from aircraft, ships, or submarines. They are inexpensive and can be used to threaten

⁴ LCDR Henry J. Hendrix, "Exploit Sea Basing," *Proceedings*, Aug 2003, 63.

⁵ Department of Defense, *Annual Report to the President and the Congress*, (Washington, D.C.: U.S. Government Printing Office, 2002), 70.

access to geographical choke points, ports, and coastal regions needed for the projection of naval power from the sea. Mines impact ships by either rupturing hulls, igniting fires, or sinking or crippling ships. During the Operation DESERT STORM, the *USS Princeton (CG-59)* and the *USS Tripoli (LPH-10)* were severely damaged by mines. Mines also prevented amphibious operations into Kuwait.

Author Paul Bracken calls the development of ballistic missiles and weapons of mass destruction “disruptive technologies”. Disruptive technologies are “aimed at the West’s military freedom to operate at will.”⁷ Germ weapons create a significant loss of life and also attack the will of the American people to maintain forces in oversea conflicts. Biological weapons “makes fixed bases and endangered species.”⁸ Because of their destructive power, the lack of accuracy of disruptive weapons becomes insignificant. Precision cruise and ballistic missiles are readily available to the adversaries of the United States. Their speed makes them hard to shoot down. Large-scale Anti-Ship Cruise Missiles (ASCMs) attacks can overwhelm ship self-defense systems. Advanced enemy Surface to Air Missiles (SAM) systems threaten U.S. forces access to hostile airspace. Disruptive technologies, such as biological weapons, move the battle focus to the rear area. Disruptive technologies have enabled other countries to deny the West’s freedom to fight from advanced bases, the ability to move forces without harassment, and the ability to restrict a war to conventional forces confined to a small geographic area.

Overseas bases, lodgments, airfields, and seaports are vulnerable to enemy attack. Saturation attacks by ballistic or cruise missiles armed with nuclear, biological, or chemical warheads could

⁶ Admiral Robert J. Natter, “Access Is Not Assured” *Proceeding*, January 2003, 39.

⁷ Paul Bracken, *Fire in the East: The Rise of Asian Military Power and the Second Nuclear Age*, (New York: HarperCollins Publishers, 1999), 49.

⁸ *Ibid*, 47.

overwhelm current U.S. air defense systems and annihilate lodgments ashore. Terrorists have shown the capacity to carry out very complicated attacks using simple rudimentary devices such as pipe bombs, grenades, and other improvised explosive devices. Having a large footprint ashore creates a significant Antiterrorism/Force Protection (AT/FP) concern and takes troops away from the main effort. The list of successful terrorist attacks on U.S. forces include: the Khobar Towers in Saudi Arabia, the Marine Corps Barracks in Lebanon, and the *USS Cole (DDG-67)* in Yemen.

Denial

The denial of access to bases limits the contribution of air and land-based power to military operations. In 1958, Greece, Austria and Switzerland denied over flight rights for the transportation of U.S. Army units from Germany to Turkey in support of Operation BLUE BAT in Lebanon. During the Arab Israeli War of 1973, most NATO allies would not allow U.S. aircraft to fly through their air space in route to Israel. USAF fighter aircraft could use European bases to provide escorts to airlift aircraft carrying supplies to Israel. Navy aircraft, flying from aircraft carriers, provided protection to cargo planes throughout the Mediterranean. In 1962, the Saudi government refused to renew the U.S. lease for bases at Dhahran Airfield, which ended the U.S. presence there.

From 1980 to 1990, the U.S. was denied access to Middle East land bases and regional military air operations depended on carrier based naval forces to supply airlift, aerial refueling, command and control, intelligence, and maritime surveillance. The Kuwaiti, Saudi Arabian, and Jordanian governments imposed landing access constraints on land-based allied aircraft performing in Operation NORTHERN WATCH in 1997 and 1998. During the air campaign against the Taliban regime in Afghanistan in Operation ENDURING FREEDOM, Arab Allies refused the United States the use of

those same U.S. built land bases for combat aircraft. In 2002, Saudi Arabia forbade the launching of tactical aircraft in support of Operation IRAQI FREEDOM.

ANTI-ACCESS CONCERNS AND SOLUTIONS FROM U.S. MILITARY LEADERS

In its study of naval expeditionary logistics, the Naval Studies Board states, “military leaders are concerned about the growing reluctance of foreign nations to allow U.S. forces to use their territory for military operations and believe that the future availability of overseas facilities is uncertain.”⁹ Since this study, high-level officers in the Navy and Marine Corps have expressed their thoughts to the public. Secretary of Defense, Donald Rumsfeld discussed his concern with anti-access strategies during a testimony before the Senate Arms Committee in 2001 stating:

Future adversaries may use advanced conventional capabilities to deny us access to distant theaters of operation, and as they gain access to a range of new weapons that allow them to expand the deadly zone to include our territory, infrastructure, space assets, population, friends, allies, we may find future conflicts are no longer restricted to the regions of origin. For all these reasons, a new approach to deterrence is needed.¹⁰

During a speech at the United States Navy Academy, Marine Corps Commandant General Michael Hagee discussed the problem of access stating:

Look at what is happening with our allies and our inability to get access to put forces ashore at what’s called an intermediate support base. My sense is that the access problem is going to become much more difficult in the future. ... And finally, the proliferation of weapons of weapons, cheap weapons, gives some of these countries the ability to come up with anti-access strategies that would prevent us from coming in. So

⁹ Naval Studies Board and National Research Council, *Naval Expeditionary Logistics: Enabling Operational Maneuver from the Sea*, (Washington, D.C: National Academy Press, 1999), 6.

¹⁰ Congress, Senate, Armed Services Committee, *Defense Strategy Review*, June 21, 2001, p. 3.

I argue that we need, the nation needs, the capability to project combat power from the sea.¹¹

When testifying before the Senate Arms Committee about the success of the military in Operation ENDURING FREEDOM, Admiral Vern Clark, Chief of Naval Operations, stated before the Senate Armed Services Committee:

I also believe that this war on terrorism is certainly a powerful demonstration of why our country needs a Navy. I believe that it is a vivid illustration of the relevance of operating from the maritime domain, the need for maritime dominance. We are taking our nation's sovereignty to the far corners of the Earth, specifically off the coast of Pakistan and Afghanistan. And the beauty of that is that we are doing it without a permission slip. We are doing it without getting the permission of some country that can say, "Yes, you can," or "No, you can't." And to me that means that "anywhere, anytime" is not just a bumper sticker. In the case of the United States Navy and its number one partner in jointness, the United States Marine Corps, it is a reality.¹²

Sea basing embodies the central points of the above quotations. It is possible that a large MAGTF will have to deploy without the benefit of overseas facilities. Sea basing forms the substitute for overseas facilities. Sea basing projects regional sovereignty of the United States around the globe. Sea basing enables the projection of power from the sea by locating command and control, fire support and logistics on afloat platforms near adversaries, rendering the tyranny of time and distance a moot issue. It circumvents anti-access and area denial strategies using the sea as the maneuver space, while minimizing vulnerable assets ashore.

¹¹ General Michael Hagee, "Toward a New Concept of Seabasing," United States Naval Academy, 4 March 2003, 3.

¹² Congress, Senate, Armed Services Committee, Seapower Subcommittee, *Hearing on FY2003 Budget for Navy Equipment on FY2003 Budget for Navy Equipment*, 9 April 2003, 2.

Sea Basing Concepts

In 1996, there existed three basic approaches to supporting amphibious operations and projecting power ashore: sea basing, sea echelon, and building up logistics ashore through beach support areas and combat service support areas.¹³ Sea basing kept the majority of the combat service support assets afloat and only sent combat service support assets ashore when the landing force needed them. Sea basing increased helicopter support requirements in order to support the landing force. Sea echelon reduced the number of amphibious ships in the immediate objective area by calling forward only those ships specifically required by the landing force. Sea echelon required that troops, supplies, and equipment were embarked correctly to correspond with phased entry. Both sea basing and sea echelon were concerned with minimizing the logistics footprint ashore. The third approach, the traditional buildup of logistics ashore, employed beach and combat service support areas to provide sustainment to the landing force.

The Marine Corps Combat Development Command (MCCDC) concept paper “Seabased Logistics” described the operational and tactical sustainment of forces operating from the sea. The concept paper describes sea basing as “a means to support littoral power projection from over the horizon, independent of sovereignty restrictions and overseas basing requirements.”¹⁴ The use of ship-to-objective logistics eliminates the requirement for lodgments on the beach. The logistics base moves with the maneuver forces, shifts lines of communication, and rapidly re-deploys to support alternate operational objectives. The concept paper identified five fundamental tenets for sea basing.

¹³ United States Navy and United States Marine Corps. *Naval Doctrine Publication 4: Naval Logistics*, (Washington, D.C.: Dept of the Navy, 10 January 1995), 69.

¹⁴ United States Marine Corps Combat Development Command, *Seabased Logistics*, (Quantico: Concepts Division, Marine Corps Combat Development Command, 12 May 1988), XI-3.

First, logistics would operate from a sea base vice depending on facilities ashore. Second, sea basing requires improved efficiency in order to reduce demand. Third, network-based, automated logistics would provide maneuver forces with in-stride sustainment. Fourth, sea based logistics would support a broad range of military operations and facilitate joint logistics ashore. Lastly, the sea base would help maintain and restore combat power at sea. The revised *Naval Doctrine Publication 4: Naval Logistics* listed the five tenets of sea basing as a future concept that “required the development of new platforms and equipment, and solution of various problems in ship-to-objective logistics, selective offload, strategic logistics interface, seabased intermediate maintenance, and joint interoperability.”¹⁵

In 2002, the *Naval Transition Roadmap* introduced “Sea Power 21” and the concepts of Sea Strike, Sea Shield, and Sea Basing. Sea Strike is a concept for naval projection of power that leverages technology to increase operational tempo, reach, and effectiveness. Sea Shield is a defensive concept that provides the nation with sea based theater and strategic defense via control of the seas and littorals, forward presence, and networked intelligence. Sea Basing supports both concepts accelerating deployment and employment time to permit ground combat power projection quickly without the reliance on existing host nation ports and airfields. Command and control, fires, and sustainment are provided from “the most mobile and secure operational area – the sea.”¹⁶

Sea Basing, described in the *Proceedings* article “Sea Power 21: Projecting Decisive Joint Capabilities,” is the foundation from which offensive and defensive fires are projected – making Sea Strike and Sea Shield realities.¹⁷ The sea base expanded from just maritime prepositioning and combat

¹⁵ United States Navy and United States Marine Corps, *Naval Doctrine Publication 4: Naval Logistics*, (Washington, D.C.: Dept of the Navy, 2001), 87.

¹⁶ United States Navy, *The Naval Transformational Roadmap: Power and Access ...From the Sea*, (Washington, D.C: Dept of the Navy, 2002)

¹⁷ Admiral Vern Clark, USN, “Sea Power 21: Projecting Decisive Joint Capabilities,” *Proceedings*, October 2002, 33.

logistics ships to include all of the ships in the expeditionary strike group: nuclear-powered aircraft carriers, multi-missioned destroyers, submarines, with special forces, and amphibious ships. Warships perform the missions of Sea Strike and Sea Shield and the sea base ships provision supplies and ammunition, complete critical repairs, and perform reception, staging, onward movement and integration (RSOI) of landing forces. Navy concepts *Naval Power 21* and *Naval Operating Concept for Joint Operations* enforce the previous definitions of Sea Basing.

Naval Power 21 states that improved sea basing across the entire naval force will “enable sea control, strike, forcible entry, special operations, sea based missile defense, dispersed logistics, strategic deterrence, and maritime interdiction operations.”¹⁸ *Naval Operating Concepts for Joint Operations* examines the far term impact of Sea Basing. In the far term, Sea Basing would enable the U.S. to protect, project, and support joint and multinational forces. Integrated combatant and auxiliary Naval Forces “will become a single, fully netted force to enhance the speed and effectiveness of expeditionary warfare.”¹⁹ These two concepts emphasize the ability of the sea base to enable forcible entry to defended littoral area and the integration of the sea base with joint logistics systems.

EARLY SEA BASING CONCEPTS

In 1904, civil engineer A. C. Cunningham developed a concept of a movable, mobile sea base. Cunningham’s movable base consisted of a series of task-oriented ships that would either move with or

¹⁸ United States Navy, *Naval Power 21...A Naval Vision*, (Washington, DC: Dept of the Navy, 2002), 3.

¹⁹ United States Naval and U.S. Marine Corps, *Naval Operating Concept for Joint Operations*, (Washington, D.C.: Dept of the Navy, 2003), 12.

follow behind the fleet and would offer all the essential services required of a base.²⁰ The ships of the movable base included sectionalized floating dry docks, colliers, ammunition, repair, supply, and hospital ships. Cunningham believed that the mobility of the movable base would make it useful for either defense or offense.²¹ Cunningham thought that the true value of the movable base lay in the range of its services and its organization as a unit of supply and service.²² Unfortunately, his thoughts were never acted upon. Duncan S. Ballantine, author of *U.S. Naval Logistics in the Second World War*, states, “in 1904 it was too much to expect either of the resources available to the Navy or of the then nascent interest in matters of support that such a plan could be brought to fruition.”²³

In his book *Operational Naval Logistics*, author Captain Henry E. Eccles dedicates a complete chapter towards the study of floating bases. He defines floating base support as:

... a system of logistical support whereby the supplies, services and replacement of equipment and personnel are provided from auxiliary ships and craft based within an anchorage.²⁴

Captain Eccles described service squadrons moving into a protected harbor or anchorage and providing the forces ashore with supplies, material services, and personnel services. “Supply,” states Captain Eccles, “includes the provisions, ammunition, water, and all kinds of technical spares.”²⁵ The temporary base also provided repair, salvage, and routine maintenance to vessels and aircraft and billeting, transfer, medical care, and general upkeep of personnel.²⁶

²⁰ Duncan S. Ballantine, *U.S. Naval Logistics in the Second World War*, (Princeton: Princeton University Press, 1947), 16.

²¹ Ibid.

²² Ibid.

²³ Ibid, 17.

²⁴ Captain Henry E. Eccles, *Operational Naval Logistics*, (Newport: U.S. Naval War College, 1950), 87.

²⁵ Ibid, 89.

²⁶ Ibid.

Captain Eccles believed that there was no facility that could not be placed on a floating naval base. Hospital ships provided for medical care equivalent to the most complete general hospital.²⁷ Personnel barges received and handled transient and replacement personnel.²⁸ Water distillation services supported ships and helped support shore facilities.²⁹ Aircraft maintenance on sea and land base aircraft could be conducted onboard the floating base.³⁰

Captain Eccles believed the major important characteristics of the floating base were mobility, flexibility, economy, and simplicity. With regards to mobility, Captain Eccles believed that every barge and lighter should be designed for “ready ocean towing at ten knots or better.”³¹ Larger auxiliary ships and tugs would be essential for moving the floating base. Tenders and repair ships - combined with hospital ships, personnel barges, boat pools, and lighters - gave the floating base a great deal of flexibility. The mobility and flexibility of the floating base made it economical since it could be used in multiple theaters.³² Captain Eccles believed that the floating organization was simpler and less complex for the Navy. Communications were self-contained onboard Navy ships. There was no competition for real estate, unloading priorities, and construction priorities, which was the source of interservice friction.³³

Captain Eccles also spoke about the limitation of the floating base. During World War II, Navy ships had neither the communication suite nor the administrative facilities capable of satisfying the

²⁷ Ibid.

²⁸ Ibid.

²⁹ Ibid.

³⁰ Ibid.

³¹ Ibid.

³² Ibid, 91.

³³ Ibid.

needs of major commands and their large staffs.³⁴ Floating bases were susceptible to poor weather conditions including storms and ice conditions. Harbors too small to accommodate sufficient floating facilities could seriously handicap the operations on the floating base.³⁵

The aforementioned examples illustrate that sea basing is not a novel concept. The around-the-world cruise of the battleship fleet in 1907 exposed the lack of logistics planning that embodied the U.S. fleet. During the two-year deployment, the fleet, which consisted of sixteen battleships and various auxiliary ships, received coal from U.S.-owned naval colliers at only two ports, Trinidad and Rio de Janeiro. Elsewhere, the fleet depended upon chartered colliers, its own coaling stations, and especially other foreign sources. Seventy percent of the coal delivered to the fleet came from foreign sources.³⁶ The need for scheduled refueling, replenishment tables, and methods of estimating, allocating and distributing supplies was obvious. As the Navy developed into an ocean going force, capable of meeting and defeating an enemy fleet before it reached U.S. waters, the need to provide logistics over vast distances would dominate the ability of the U.S. military to project power overseas.

EXAMPLES OF SEA BASING

Service Squadron TEN

During the Pacific Campaign of World War II, Service Squadron (SERVRON) TEN of the Service Force, U.S. Pacific Fleet (SERVPAC), sustained a major portion of the Pacific Fleet from

³⁴ Ibid, 92.

³⁵ Ibid.

³⁶ Ballantine, 19.

1944 to 1945.³⁷ In the Okinawa campaign, units of SERVRON TEN provided support from Kerama Retto, located just 30 miles from the invasion beaches. The original floating base was constituted on 2 April 1945 as a replenishment area. Repair facilities consisted of 2 landing craft repair ships (ARLs) and 1 dock landing ship (LSD). With the Okinawa operation but a few days old, battle damage to ships required a number of tenders and repair ships to be called forward from Ulithi and Guam. In its largest formation, the floating base contained 3 battle damage repair ships (ARBs), 2 LSDs, 1 repair ship (AR), 4 floating dry docks (ARDs), 1 destroyer tender (AD), 1 miscellaneous auxiliary ship (AG), and 2 ARLs. Under the constant threat of Kamikaze attack, SERVRON TEN provided every kind of service from its anchorage in Kerama Retto. The tanker *Ponaganset* discharged water cargo to damaged vessels, and various patrol, amphibious, and mine craft. A suicide aircraft hit the hospital ship *Pinkney* on 28 April. Fleet tug *Molala* and several landing craft extinguished the flames onboard *Pinkney* in three hours. The *Molala* remained alongside and provided the *Pinkney* with supply power to enable the dewatering of the engine room. After being towed to a more protected anchorage, *Pinkney* was repaired, deemed seaworthy, and returned to the rear area. From 28 March to 16 May, 37,915.6 tons of ammunition, 1,295,000 barrels of black oil, and 337,000 barrels of diesel fuel was distributed from the floating base at Kerama Retto. During the same period of time, 10 supply ships discharged 25,372 tons of cargo at Okinawa.³⁸

³⁷ Ibid, 87.

³⁸ Rear Admiral Worrall R. Carter, *Beans, Bullets, and Black Oil*, (Washington: Department of the Navy, 1953), 345.

Korean War

Between 1945 and 1950, the military school of thought was that the Navy's functions in future war would be limited to convoy and patrol duties. The ability of the Navy to exercise control of the seas between Korea and the United States changed those observations. Command of the sea allowed U.S. forces to project its power ashore by amphibious operations and allowed logisticians "to use the greater carrying capacity of ships to shorten land lines of communication."³⁹ Operations by ground and air forces were completely dependent on a steady flow of personnel and supplies from overseas. Without sea power "the United States could never have gotten her soldiers and their equipment, her airmen and their aircraft, to the scene of the conflict, nor supplied them once there. Nor could the weight of the nation's strength have been applied upon the enemy without the American Navy."⁴⁰

Using bases in Japan as intermediate staging and embarkation points (ISEPs), naval mobile logistic support systems provided adequate support to all demands while obviating the need for extensive construction of seaports ashore. Six of every seven people who went to Korea went by sea and every soldier that landed in Korea was accompanied by five tons of equipment.⁴¹ The ships of the Military Sea Transport Service (MSTS) and other fleet transport vessels embarked Marine, Army and Air Force reinforcements in the United States and Europe and delivered them to Japan and Korea. The expanding needs of the Army, Air Force and Navy doubled the loadout for MSTS Pacific ships. At the start of the war, MSTS had 25 vessels available to lift forces and supplies to Korea. By September 1950, the number of MSTS ships increased to 117 vessels and by 1 November the number of MSTS

³⁹ Julian Thompson, *Lifeblood of War: Logistics in Armed Conflict*, (London: Brassey's, 1991), 131.

⁴⁰ CDR Malcolm W. Cagle, USN, and CDR Frank A. Manson, USN, *The Sea War in Korea*, (Annapolis: United States Naval Institute, 1957), 492.

⁴¹ *Ibid*, 491.

ships increased to 263. From July to September 1950, MSTS ships carried forward 136,000 passengers and 1,984,000 tons of cargo. The flexibility and mobility of these ships gave General MacArthur the option of deploying troops to either staging areas in Japan or into the front lines at Pusan or Inchon.

The logistic forces of Task Force 7 provided the initial sustainment for the 1st Marine Division's landing at Inchon. MSTS ships disembarked troops into landing craft and tank landing ships (LSTs), which moved to the designated assault beaches. Oilers and ammunition ships maintained a floating logistics base off Inchon. Naval leaders beached eight LSTs, each loaded with 500 tons of food, water, ammunition, fuel, and vehicles. These materials directly contributed to the Marine's ability to hold their positions. After the Marines secured a lodgment, Naval Beach Group 1 and a Marine Shore Party battalion landed and unloaded 4,000 tons of cargo from the LSTs. Damaged LSTs were replaced with other fully loaded ships. MSTS transports brought in more Marines, South Korean Marines, and Army infantrymen.

Replenishment at sea kept aircraft carriers and other warships on the line. In the first days of action, naval units refueled and rearmed in port at Buckner Bay, Sasebo, and Pusan. But the need to keep the aircraft carriers on station required naval surface forces to shift to underway replenishment. After 23 July 1950, Task Force 77 refueled at sea. By the end of 1950, Service Squadron THREE's fleet oilers completed 100 carrier, 11 battleship, 50 cruiser, and 546 destroyer refueling at sea. Various attack cargo ships (AKA) rearmed the force on 54 occasions. One oiler was maintained at Keelung to refuel the Formosa Strait patrol. Two tankers and one to two ammunition ships remained in the Sea of Japan to meet the larger needs of the force. By 1952, it was possible to replenish the entire fast carrier task force in nine hours. One result of the refueling at sea operations was the need for replenishment

ships with more speed and longer hulls and the desirability of developing composite replenishment ships that could issue more than one commodity at a time.

Vietnam War

Much of that which was transferred at anchor in a protected harbor in World War II was accomplished at sea during the Vietnam War. The lack of adequate deep-draft ports in Vietnam made U.S. forces depend on “logistics-over-the shore” type operations.⁴² The port of Saigon was the only major deep-draft port in the Republic of Vietnam, but the depth of its water and pier space limited its ability to conduct major logistical operations. Cam Ranh Bay, the only other port that accommodated ocean-going ships, had only one small pier.

Service Force, U.S. Pacific Fleet (SERVPAC), controlled and coordinated logistic ships and shore support facilities throughout Southeast Asia. SEVRON THREE, based in Sasebo, Japan, served as Seventh Fleet’s Logistic Support Force (Task Force 73). Task Force 73 provided the fleet with ammunition, petroleum products, supplies, repairs, repair parts, communications, towing and salvage, port service, and medical support.

The replenishment of fleet combatants at sea enabled warships to operate for long periods at Yankee and Dixie Stations, on the Market Time patrol, and on the naval gunfire support line.⁴³ Seventy to ninety percent of the fleet’s requirements for fuel and ammunition were completed by underway replenishment.⁴⁴ Ninety-seven percent of the provisions and over seventy percent of the

⁴² Edwin B. Hooper, *Mobility, Support, Endurance: A Story of Naval Operational Logistics in the Vietnam War 1965-1968*, (Washington: Naval History Division, Department of the Navy, 1972), 6

⁴³, Edward J. Marolda *By Sea, Air, and Land: An Illustrated History of the U.S. Navy and the War in Southeast Asia*, (Washington: Naval Historical Center, Department of the Navy, 1994), 239.

⁴⁴ Ibid.

stores were also transferred at sea.⁴⁵ Oilers traveled from Subic to either Yankee or Dixie Station, where they would replenish the carrier task group. Then, the oilers would replenish ships in either the northern or southern Market Time stations and then return to Yankee and Dixie Stations before returning to Subic. Two new ships, the fast combat support ship (AOE) and combat stores ship (AFS), were valuable assets for SERVPAC. Each had the capability to perform vertical replenishment using the two helicopters embarked on each ship. These ships traveled along the coast and up into the Tonkin Gulf transferring cargoes without stopping or going alongside. *Sacramento* (AOE-1) provided Seventh Fleet ships with over 67 million gallons of fuel; over 14,000 tons of ordnance; over 1,800 tons of provisions; 1,624,000 pounds of stores, fleet freight and mail; and 930 passengers.⁴⁶

Other vessels contributed to the fleet readiness in Vietnam. Repair ships and tenders provided repairs to ships. Communication relay ships, *Annapolis* (AGMR-1) and *Arlington* (AGMR-2), provided specialized communications and electronics repair support. Hospital ships *Repose* and *Sanctuary* carried the most modern equipment and a complement of skilled doctors, nurses, and corpsmen. Medical evacuation helicopters took no longer than thirty minutes to fly wounded troops from their units to the ships. Salvage ships such as the *Reclaimer* (ARS 42) and fleet tug *Lipan* (ATF 85) freed grounded vessels. Medium and light crafts, comprising of Harbor Clearance Unit 1, recovered vessels sunk in the littorals of South Vietnam.

⁴⁵ Hopper, 47.

⁴⁶ Ibid, 56.

Operation DESERT SHIELD/DESERT STORM

At the height of sealift operations on 31 December 1990, Military Sealift Command had 217 ships under service, forming a “steel bridge” across the Atlantic Ocean to the Persian Gulf. By the end of the war, these ships moved over 945,000 pieces of equipment to the United States Central Command (CENTCOM) area of responsibility (AOR). MSC transported 3.1 million tons of dry cargo products and 6.1 million tons of petroleum products by sea. MSC used 69 tankers to support DESERT SHIELD/DESERT STORM fuel demands. The tankers delivered fuel to the theater from the ports as distant as the United States and the Caribbean.⁴⁷ The Navy’s prepositioning ships had a major role in sealift of troops, equipment and supplies to the CENTCOM AOR.

Operation DESERT SHIELD/DESERT STORM validated the afloat prepositioning concept. A Navy modernization program in the 1980s directly contributed to the nation’s sealift achievements during the war. In order to counteract the post-Vietnam War reduction in amphibious lift capability and to provide theater assets in the Arabian Gulf after the fall of the Shah of Iran, the Near-Term Prepositioning Force was formed. The service acquired and converted sealift ships capable of transporting a Marine Expeditionary Brigade (MEB) to Europe in five days or the Persian Gulf in two weeks. The Near-Term Prepositioning Force contained the equipment and supplies for a MEB. The Afloat Prepositioning Force consisted of 13 Maritime Prepositioning Ships (MPS) and 12 Prepositioning Ships (PREPO). The Maritime Prepositioning Ships were divided into three Maritime Prepositioning Squadrons (MPSRONs), one each in the Atlantic Ocean, Indian Ocean, and Pacific

⁴⁷ All statistical information for Opeartion DESERT SHEILD/DESERT STORM originated from James K. Matthews and Cora J. Holt, *So Many, So Much, So Far, So Fast: United States Transportation Command and Strategic Deployment for Operation Desert Sheild/Desert Storm*, (Washington, D.C.: Joint History Office, Office of the Chairman of the Joint Chiefs of Staff and Research Center, U.S. Transportation Command, 1996).

Ocean. Each squadron was capable of equipping and supplying a MEB for 30 days. A typical MPS squadron contained 50 M-60 tanks, 100 Amphibious Assault Vehicles, 30 light armored vehicles, 40 155mm howitzers, 300 5-ton trucks, and 1.5 million meals. After their initial preposition voyages, seven of the thirteen ships were used as common-user transport ships. The other ships in the theater served as sea based logistics platforms, providing ammunition and fuel. The MPS ships moved 164,328 tons of cargo, which accounted for 10.5 percent of the DESERT SHIELD/DESERT STORM total cargo.

Operation DESERT SHIELD/DESERT STORM exposed the risks of depending on foreign flagged sealift vessels. The decline of the U.S. Merchant Marine affected the availability and timeliness of capable ships from the both the U.S. and worldwide commercial fleets. Competition among the allies for merchant vessels exacerbated the problem. From late December 1990 to the end of the war, foreign flagged merchant vessels carried nearly 40 percent of U.S. unit cargo. General Hansford T. Johnson, USAF, Commander United States Transportation Command, remarked, “it worked okay this time, but what if foreign governments don’t go along with the operation [next time]?”⁴⁸

The hesitation or refusal of some foreign flag crews to complete their voyage to the Persian Gulf raised the question of foreign flag shipping dependability in future conflicts. This problem could get worse if the United States acts unilaterally or without the worldwide support that it experienced during DESERT SHIELD/DESERT STORM. For a variety of reasons, crews on at least 13 foreign flag vessels carrying U.S. cargo hesitated or refused to enter the AOR. Three foreign-manned feeder ships operating for U.S. flag ship companies under MSC’s sustainment arrangement, the Special

Middle East Sealift Agreement (SMESA). The Qatari flag *Trident Dusk*, carrying 2,371 tons of combat support and combat service support equipment to Saudi Arabia, refused to enter the combat zone.

Thus, we can see that Naval expeditionary logistics have provided sustainment from over the horizon in multiple operations. In the above examples, the capabilities of the fighting force ashore “were dependent on the effectiveness of the supporting organization.”⁴⁹ The Pacific Campaign of World War II demonstrated that floating logistics bases, located at secure anchorages close to the front, could provide force sustainment without regard to distance from U.S. shores. However, the lodgments established on enemy beaches were vulnerable to enemy action and required large allocation of forces to provide base protection. The Korean and Vietnam Wars, plus Operation DESERT SHIELD/STORM, showed U.S. dependence on host nation support for intermediate staging and embarkation bases. Operation DESERT SHIELD/DESERT STORM exposed U.S. dependence upon foreign flag merchant vessels.

Sea basing capitalizes on the lessons learned from World War II to Operation DESERT SHIELD/DESERT STORM. Sea basing advances the role of maritime prepositioning ships from at-sea warehouses for Army, Air Force, and Marine Corps equipment to include at-sea arrival and assembly of forces. Sea basing reduces the need for vulnerable airfields, seaports, and beach lodgments in the immediate area of operations. Sea based forces marry up with equipment and become operationally ready while the sea base moves to the AOR. Sea bases large enough to carry the equipment and materials for the MEB reduces the need for foreign merchant shipping to augment U.S.

⁴⁸ Ibid, 129.

sealift platforms. Sea basing allows for the reconstitution of the landing force at sea, which enables the rapid redeployment of troops to another operational area. The platforms required to perform sea basing will not be the ones used in earlier wars. New platforms are required to expand the capabilities of today's sealift assets.

THE PLATFORMS FOR SEA BASING

There currently exist two philosophies for developing platforms for Sea Basing: Maritime Prepositioning Force (Future) [MPF(F)] and the Mobile Offshore Base (MOB). MPF(F) replaces the existing fleet of prepositioning ships with vessels specifically configured to support Operational Maneuver from the Sea (OMFTS) and Ship to Objective Maneuver (STOM) from a sea base operating from over the horizon. The MOB is a self-propelled, floating logistics platform consisting of one or more serially connected modules. The MOB operates strategic airlift aircraft and provides joint forces with maintenance, supply, housing, and other forward logistics support operations.

Today's Maritime Prepositioning Force

The current MPF allows U.S. Naval Expeditionary Forces (NEFs) to combine the lift capacity, flexibility, and responsiveness of surface ships with the deployment speed conferred by strategic airlift. Today, the MPF consists of 16 ships. Each squadron contains four to six ships. When required, these ships move to a crisis area and offload either in ports or "in-stream" on a suitable beach. MPF ships

⁴⁹ James A. Field, Jr., *History of United States Naval Operations: Korea*, (Washington, D.C.: U.S. Government Printing Office, 1962), 385.

can discharge cargo along a pier or while at anchor, and can launch amphibious craft and vehicles using a submerged stern ramp. Offloaded equipment and supplies are then “married up” with Marine units arriving by strategic airlift at nearby airfields. This process allows a combat-ready Marine Air-Ground Task Force (MAGTF) to assemble rapidly using minimal reception facilities. The ships from one MPF squadron provide enough supplies and equipment to support approximately 17,000 Marines for 30 days. The MPF is flexible enough to support any size MAGTF, from a Marine Expeditionary Unit (MEU) to a Marine Expeditionary Force (MEF), by combining multiple MPF squadrons.

Maritime Prepositioning Force (Future)

In 1980, the Near Term Prepositioning Force (NTPF) loaded ships with equipment and supplies for the Marine Expeditionary Force (Forward) [MEF(FWD)]. The ships required a seaport to offload cargo, an airfield to be the aerial port of debarkation (APOD) for Marines flying into the theater, and a large shore-staging area to allow forces and equipment to associate. The MPF, first delivered in 1985, carried organic lighterage to allow in-stream offload of the ships, which decreased the reliance on fully furnished seaports. Between 1999 and 2002, the introduction of new and upgraded combat equipment for Marine Corps personnel required additional afloat capacity within the MPS. The Maritime Prepositioning Force (Enhanced) [MPF(E)] program was designed to increase the lift capacity in each prepositioning squadron by adding an enhanced MPF ship to each of the three MPS squadrons. However, the MPF(E) program did not meet the requirements set forth in the Marine Corps’ warfighting concepts for the 21st century.⁵⁰ The Marine Corps Combat Development Command (MCCDC) published the “Maritime Prepositioning Force (MPF) 2010 and Beyond” concept paper in

1997, which has been followed by the MPF(F). A Navy and Marine Corps working group drafted the *Mission Needs Statement (MNS) for Maritime Prepositioning Force for the 21st Century [MPF Future (MPF(F))]* in February 2000. Signed by the Chief of Naval Operations in June 2001, the *MNS for MPF(F)* created a guide for the research and design of platforms and platform specific systems in support of MPF(F) based on the pillars stated in the “MPF 2010 and Beyond” and “Seabased Logistics” concept papers. The new ships would replace current MPF vessels and would be operated by Military Sealift command.

Center of Naval Analysis MPF(F) Concepts of Operations

The Office of the Chief of Naval Operations, Logistics Plans and Policy/Strategy Sealift Programs Division (N42) and Expeditionary Warfare Division (N85) tasked a Mission Area Analysis (MAA) to develop alternative ship concepts for future MPF Marine Air-Ground Task Force (MAGTF) mission use. The MAA study team comprised representatives from the Center of Naval Analyses (CNA); Naval Surface Warfare Center (NSWC), Carderock Division; Naval Facilities Engineering Service Center (NFESC); Naval Sea Systems Command (NAVSEA)/Advanced Marine Enterprises (AME); Band, Lavis Associates (BLA); and the American Bureau of Shipping. One major goal of the MAA was to develop alternative ship concepts for MPF(F). These conceptual ships used current and evolving technology to develop solutions that could be achieved within state-of-the-art shipbuilding technology. Band, Lavis & Associates (BLA) and Naval Sea Systems Command (NAVSEA) were tasked in the MAA to develop cost-effective monohull ships concepts for the MPF(F).⁵¹ Under the

⁵⁰ John M. Curatola and Robert Bovey Jr, “The Future Maritime Prepositioning Force,” *Proceedings*, November 2001, 87.

⁵¹ Robert M. Souders, “Mission Area Analysis for MPF Future/Sea Basing Concepts Final Briefing” (Alexandria: Center for Naval Analyses, 1998), 4.

supervision of CNA, the two organizations independently evaluated on load/off load alternatives and options, storage and assembly area options, ship space and material needed for aircraft maintenance, shipboard maintenance of vehicles and equipment, resupply of the sea base, medical support for the MAGTF, and high-speed surface transport. The American Bureau of Shipping assisted the ship design agents to ensure that designs developed would meet commercial standards. NAVSEA augmented its in house design by contracting the assistance of Advanced Marine Enterprise, Inc (AME).

The MAA created a series of concepts of operations (CONOPS) in order to bound the ship alternatives created in the study. The CONOPS were labeled ‘A’, ‘B-’, ‘B’, ‘C’, ‘C+’, ‘D’, and ‘D’. CONOPS ‘A’ represented the current MPF concept of operation. The MAGTF deploys in order to reinforce an ATF already operating in the Amphibious Operations Area (AOA). MAGTF personnel fly into a host nation supported airport. The MPSRON deploys from a prepositioning site to a host nation supported seaport, with a staging area and nearby airfield. The ships are unloaded and MAGTF personnel “marry up” with their equipment. In this scenario, all aircraft are based at a host nation supported air base. CONOPS ‘A’ had no sea base and was only used to establish a base scenario for the MAA study.

In CONOPS ‘B-’ and ‘B’, which support the ships of Alternatives ‘B-’ and ‘B’, the MPSRON deploys from a prepositioning site and meets the MAGTF personnel at an ISEP. In CONOPS ‘B-’, only portions of the CE, GCE, and CSSE meet the sea base, while the others deploy to the site of the ACE Land Base. In CONOPS ‘B’, all of the CE, GCE, and CSSE personnel board the sea base at the ISEP and sail to a MPF Operations Area (OPAREA) near the ATF. The sea base would provide support to forces engaged ashore, and to the CE, and CSSE, which would remain onboard the sea base

indefinitely.⁵² The entire ACE, consisting of 62 rotary aircraft, is located at a host nation supported ACE land base located close to the AOA. The sea base would only have the capability to refuel the rotary aircraft. CONOPS 'B-' requires 4,600 Marines, while the sea base in CONOPS 'B' requires 10,600 Marines.

In CONOPS 'C', which supports the ships of Alternative 'C', the rotary-wing component of the ACE is based, operated, and maintained on the sea base. The fixed-wing component requires an ACE land base for deployment. These ships interface and refuel air-cushioned landing craft (LCACs) and the ship-to-shore lighters. CONOPS 'C' ships have berths for 13,500 MAGTF personnel. The CE, GCE, CSSE and all rotary aircraft embark on the sea base at a host nation supported ISEP.

CONOPS 'C+' is identical to CONOPS 'C' with the exception of the stationing of fixed-wing aircraft. Navy carrier-based aircraft perform the functions of the fixed-wing component of the ACE. The aircraft carrier eliminates the requirement for an ACE land base and reduces dependence on host nation support bases. However, the aircraft carrier does not service C-130 Hercules aircraft, which requires longer runways than those provided on aircraft carriers. The ships in this concept of operation require a host nation supported ISEP for the embarkation of CONUS-based troops. The sea base in this concept of operations can project the force ashore and then provide sustained logistics and close air support.

In CONOPS 'D', which supports the ships of Alternative 'D', the sea base has the material and supporting structure to base the MAGTF, and all V/STOL and rotary-wing aircraft of the ACE. The MAGTF flies into a host nation supported ISEP, where it meets and boards the MPSRON sea base

⁵² John Nance, Jr., Vito R. Milano, Robert M. Souders, and Thomas A.. Bowditch, *MAA for MPF Future Sea-Basing Concepts: Phase I Summary Report*, (Alexandria: Center for Naval Analysis, 1997), 19.

ships. The sea base transits from the ISEP to the AOA. During the transit, the equipment is configured for the performance of the tactical mission. The sea base has the ability to house 16,400 Marines. In this scenario, only the MAGTF strategic lift aircraft are based ashore. The sea base in this concept of operations can project the force ashore and then provide sustained logistics and close air support.

In CONOPS 'E', the MOB is the sea base. MOB single base units (SBU) transit from its homeport to the AOA. Five SBUs assemble into a fully functional MOB once located adjacent to the AOA. The MAGTF deploys directly from its home base, inside the U.S., directly to the MOB in theater and forms a combat MAGTF on the MOB. Strategic lift aircraft are able to land on the 5,000 foot length of the MOB. The MOB would have the storage capability to handle the total MAGTF lift of vehicles, dry cargo, and cargo fuel; accommodate a total of 17,000 MAGTF personnel; house, maintain, and operate all MAGTF rotary and fixed-wing aircraft; and operate strategic lift aircraft.⁵³ The sea base in this concept of operations requires neither an ISEP nor an ACE land base.

Band, Lavis & Associates MPF(F) Designs

BLA defined a common parent hull that could accommodate the lift requirements of the MAGTF. Single hull ship design preferences are based on designs of current Large, Medium Speed, Roll-On/Roll-Off (LMSR) ships. The BLA sea base ships share a common hull, a common propulsion plant, and internal design from the keel to the main deck. The port side quarter stern ramp on each ship allows for pierside roll-on and roll-off of cargo, equipment, and vehicles. An external integrated

⁵³ John F. Nance, Jr., Robert M. Souders, and Douglas A. Adams, "MAA for MPF Future Sea-Basing Concepts: Volume III Ship Design Technical Reviews" (Alexandria: Center for Naval Analyses, 1998), 17.

landing platform (ILP) allows for assault craft interface on the starboard quarter. An internal-external gantry crane system runs along the port side underneath the flight deck overhang. Each ship is approximately 1,000 ft in length and has a draft of 35 ft. To minimize the weight, cost, and internal hull volume required to house the powerplant, BLA selected as the common powerplant four General Electric LM-2500 gas turbine engines, two per shaft, driving two 27-foot controllable pitch propellers. Each ship would also be provided a bow thruster to assist maneuvering at slow speeds. The propulsion plants of these ships will be capable of transit speeds of 25 knots. The BLA designs are split into three mission types: ACE Supply ship, Minimum Air-Capable Ship, and Fully Air-Capable Ship.

The Minimum Air-Capable Ship provides support for MAGTF non-aviation forces and carries a significant percentage of the MAGTF load out, including the personnel lift associated with the CE, GCE and the CSSE. The Minimum Air-Capable Ship has a large flight deck forward and a large superstructure house on the aft portion of the flight deck. The flight deck will be capable of servicing and operating rotary-wing aircraft, but the ship will not have the capability to either house or maintain aircraft. The Minimum Air-Capable Ship will have an intermediate level vehicle maintenance capability and will also carry the majority of the MPF organic lighterage in the hanger area.

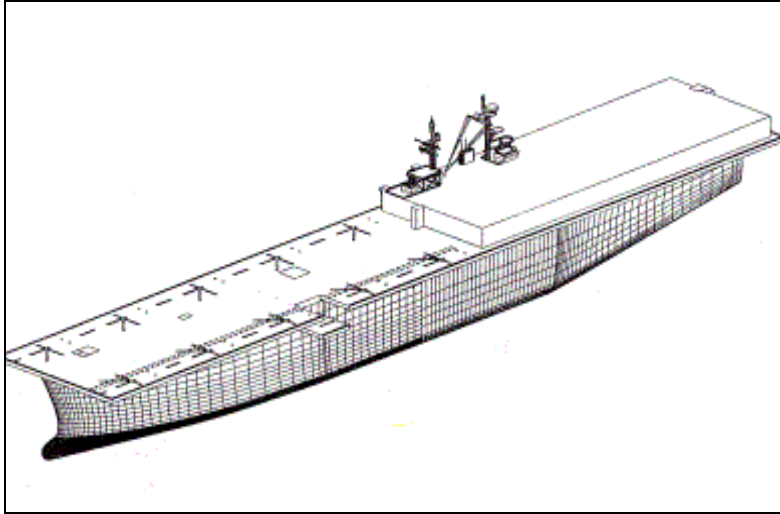


Figure 1. BLA Minimally Air-Capable Ship

The Fully Air-Capable Ship is dedicated to the housing, maintenance, servicing, and operation of all ACE aircraft. On the starboard side of the flight deck, the Fully Air-Capable Ship has a smaller superstructure house, which leaves enough space on the starboard side for the runway to be extended the full length of the ship. While the Minimum Air-Capable Ship functions as a helicopter carrier, the Full Air-Capable Ship will have the capability to operate the JSF, as well as helicopters. These ships will have a full sea basing capability, including an extensive aircraft maintenance capability. A 50,000 square foot hanger contains all aviation maintenance and support facilities, with required spare parts and test equipment support provided by the fly-in support package (FISP), which is flown in as a part of the FIE. The maintenance capability of the Fully Air-Capable Ship is raised to an Intermediate Level capability after the ship is joined with a Maintenance Aviation Support Ship (T-AVB), which arrives as a part of the MPF. The Fully Air-Capable Ship will primarily carry the cargo and personnel associated with the embarked aircraft support and operation and a percentage of the MAGTF loadout.

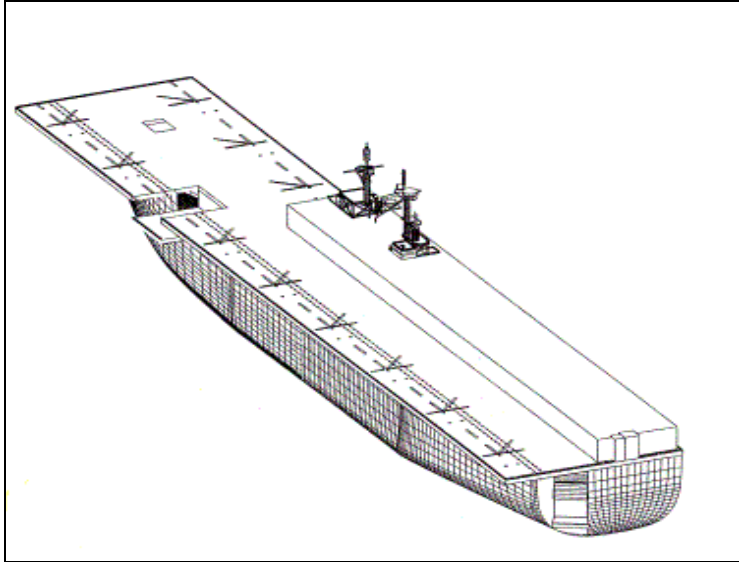


Figure 2. BLA Fully Air-Capable Ship

Dedicated to sustaining support for the ACE when it is based ashore, the ACE Support Ship carries the vehicles, dry cargo containers, and cargo fuel for the full ACE. It has the main deck removed in the aft portion of the ship to allow more containers to be stowed on the “B” deck.

Table 1 shows the mix of ships in the BLA designed sea base. In CONOPS ‘B-’ and ‘B’, the entire ACE is based at a host nation supported airbase and the Minimally Air-Capable Ships only provide refueling services. In CONOPS ‘C’, the ACE Support Ship carries the cargo associated to support the fixed-wing portion of the ACE, which is based ashore. In CONOPS ‘C’, one Fully Air-Capable Ship embarks all the rotary-wing aircraft of the MAGTF. In CONOPS ‘D’, the complete ACE is embarked on the sea base. Two Fully Air-Capable ships provide sea based support of ACE aircraft and ACE Support Ships are not required as a part of the MPSRON. One Fully Air-Capable Ship embarks the rotary-wing aircraft, while the other embarks all of the MAGTF fixed-wing aircraft. However, both ships are flexible enough to embark a mix of rotary- and fixed-wing aircraft.

CONOPS	Fully Air-Capable Ship	Minimally Air-Capable Ship	ACE Support Ship	Total squadron number of ships
B-	-	2	1	3
B	-	2	1	3
C	1	2	1	4
C+	1	2	-	3
D	2	2	-	4

Table 1. BLA squadrons mix

Naval Sea Systems Command and Advanced Marine Enterprises Designs

Naval Sea Systems Command (NAVSEA) enabled its design efforts by contracting the services of Advanced Marine Enterprises (AME). The NAVSEA/AME team based all of their platform designs from one generic ship hull. From the keel to the flight deck, each of these ships maintained the same design. These deep draft ships are longer and wider than the SACRAMENTO Class (AOE-1) Fast Combat Stores Ship and the WASP Class (LHD-1) Multi-Purpose Amphibious Assault Ship. The enclosed hull of the generic NAVSEA/AME ship is deep due to the large number of enclosed cargo decks required to accommodate the very large MAGTF loadout of vehicles and dry cargo. The generic ship is designed to have seven cargo decks in the forward portion of the ship configured to carry most of the MAGTF vehicles, dry cargo and cargo fuel. Two single-pedestal cranes, located forward of the superstructure, gave the generic ship design a “Lift On – Lift Off” (Lo-Lo) capability. The superstructure provides command and control, and troop accommodations. A side ramp in the well deck gives ships a “Roll On – Roll Off” (Ro-Ro) capability for the embarkation of wheeled vehicles. A large flight deck supports rotary-wing operations. The after portion on the ship is configured for the

main propulsion machinery spaces and the enclosed well deck. The main propulsion room would contain four medium-speed, Colt-Pielstick PC4.212V diesel engines that would power two shafts. These twelve-cylinder engines are similar to the ten-cylinder models currently used on the T-AKR-300 class sealift ships. Each ship would have the propulsion capable of maintaining a speed of 25 knots. Cargo fuel is stored in either the centerline tanks or in the deep tanks in the forward portion of the ship. NAVSEA/AME developed designs for eight discrete ships types for MPF(F), including three Minimally Air-Capable Ships, two Fully Air-Capable Ships, two ACE Support Ships, and a Partially Air-Capable Ship.

Each Minimally Air-Capable Ship had three active aircraft spots for rotary-wing aircraft. Each ship accommodated the same cargo fuel, vehicle stowage, and container and pallet capacity. Where the Minimally Air-Capable Ships differed was in their accommodations for embarked Marines. The Minimally Air-Capable Ship designed for CONOPS 'B-' accommodated 1,100 Marines, for CONOPS 'B' accommodated 2,610 Marines, and for CONOPS 'C' accommodated 1,755 Marines. Each Minimum Air-Capable Ship carries 10 folded helicopters and the hanger could hold two additional helicopters.

The Partially Air-Capable Ships, which differs slightly from the Minimally Air-Capable, employs only two active air spots and can accommodate 2,240 Marines. It also stores less cargo fuel than the Minimally Air-Capable ships. The superstructure house is raised on this ship for the creation of a hanger.

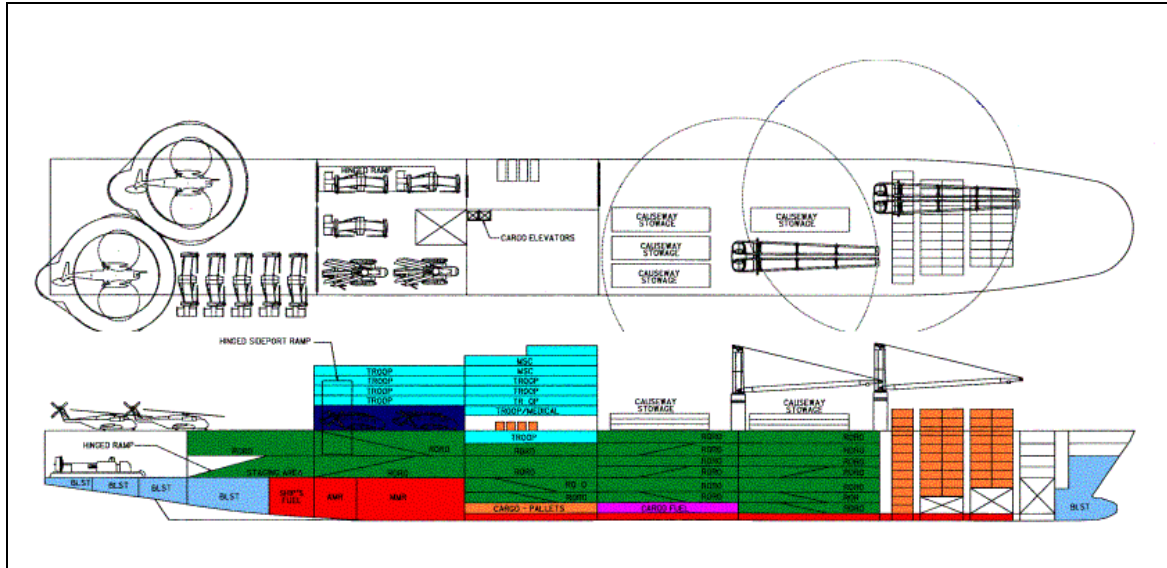


Figure 3. NAVSEA/AME Partially Air-Capable

The two ACE Support Ships of the NAVSEA/AME design are slightly larger than the Partially Air-Capable Ships. They house up to 84 Marines and have a single active aircraft spot for rotary-aircraft. Both ships maximize the space below the main deck for the stowage of wheeled vehicles. The only difference between the CONOPS 'B/B-' ships and the CONOPS 'C' ships is the cranes. The CONOPS 'C' ship employs two double pedestal boom cranes, while the CONOPS 'B/B-' ship uses two single pedestal cranes.

NAVSEA/AME team designed two Fully Air-Capable Ships for CONOPS 'C' and 'D'. On both ships, the crane was installed aft of the superstructure house to accommodate the resupply of the sea base from non-self sustaining ships alongside. The first of the two Fully Air-Capable Ships has a flight deck similar to the IWO JIMA Class Amphibious Assault Ship (Helicopter). The CONOPS 'C' Fully Air-Capable Ship employs six active aircraft spots and has the capability to embark 34 rotary-

wing aircraft. The well deck and Ro-Ro capabilities were removed from this design. The superstructure house is lengthened and narrowed to occupy only the starboard side in order to leave room on the port side for the longer flight deck. The CONOPS 'D' Fully Air-Capable Ship has the ability to operate and service 30 Joint Strike Fighter (JSF) Vertical Standing Take-Off and Landing (VSTOL) aircraft and helicopters. With a flight deck and island structure resembling an aircraft carrier, this version of the Fully Air-Capable Ship accommodates 1,490 Marines and has the a cargo fuel capacity of 6,330 cubic meters. Additional emphasis is placed on the layout of the flight deck, hanger deck, and aviation shops in order to ensure maximum efficiency of space.

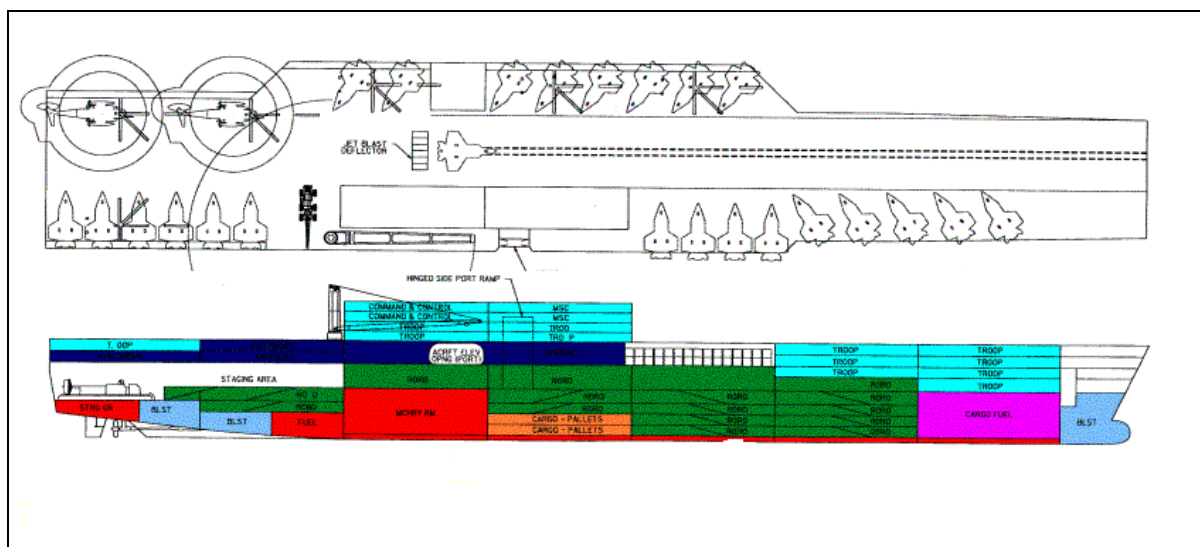


Figure 4. CONOPS 'D' Fully Air-Capable Ship

Table 2 displays the NAVSEA/AME sea base squadron mix. The Minimally Air-Capable Ships were designed for CONOPS 'B-', 'B', and 'C'. The Partially Air-Capable Ship was designed for CONOPS 'C' and 'D'. On the sea base ship for options "C", "C+", and "D", helicopters are proportionally loaded on each of the ships required in the MPF(F) squadron. A single larger ship,

carrying the rotary-wing portion of the Air Combat Element (ACE), is required to form sea base option “C”. Option “D” requires 8 total ships; 6 Partially Air-Capable helicopter sea base ships, and 2 Fully Air-Capable Ships. The large number of ships in this sea base squadron makes this option costly to procure and operate.

Ship Type	CONOPS B-	CONOPS B	CONOPS C	CONOPS C+	CONOPS D
ACE Support Ship (B, B-)	2	2	-	-	-
ACE Support Ship (C)	-	-	1	-	-
Minimally Air-Capable Ship (B-)	4	-	-	-	-
Minimally Air-Capable Ship (B)	-	4	-	-	-
Minimally Air-Capable Ship (C)	-	-	-	-	-
Partially Air-Capable Ship	-	-	6	6	6
Fully Air-Capable Ship (C)	-	-	-	-	-
Fully Air-Capable Ship (D)	-	-	-	-	2
Total number of ships	6	6	7	6	8

Table 2. NAVSEA/AME sea base squadrons mix

The Mobile Offshore Base

A Mobile Offshore Base (MOB) is a self propelled, modular, floating platform that can be assembled into lengths of up to 2 kilometers and deployed to provide logistic support for U.S. military operations where land bases are not adequate. MOB logistics support would be comparable to that obtained from a land base, but the MOB would be located closer to the JOA and be capable of being relocated. Compared to traditional land bases, this moveable, reusable base is not subject to the politics of other nations.

As the largest floating structure ever built, its size would be unprecedented. A single module would be 300 meters long, 150 meters wide, and 37 meters above the ocean surface. Each module consists of a box-type deck that is supported by multiple columns on two parallel pontoons. The columns provide structural support and hydrostatic stability against overturning. The pontoons provide the majority of the supporting buoyancy for the sea base.

The semi-submersible “building block” modules could be deployed in numerous different configurations to support operations ashore. Individual 300-meter modules could provide logistic support in several locations around the world. Multiple modules can be serially connected to form a floating runway up to 2 kilometers long. Formed by connecting five single modules, this MOB configuration would have the ability to accommodate conventional take-off and landing (CTOL) aircraft such as the Boeing C-17 and C-130 cargo transporters.

Each MOB module is self-propelled and can transit at speeds up to 15 knots. When transiting between operational sites, the module is deballasted and travels on the surface of the water. In this configuration, the semi-submersible hull reduces drag and can transit at high speeds on its narrow pontoons “much like a catamaran.”⁵⁴ Once on station, the module is ballasted down so that the pontoons are submerged below the surface waves. This configuration minimizes the wave-induced dynamic force, which also decreases the wave-induced motions of the deck. In sea-states where monohull ships may be rolling upward of 10 degrees, the semi-submersible hull will often be rolling less than 1 degree. This inherent low motion characteristic gives the semi-submersible hull its greatest advantage over conventional ship hulls.

⁵⁴ Dr. Robert F. Zueck, P.E. and Robert Taylor, P.E. “Mobile Offshore Base, Logistics Platform for the 21st Century” *Year 2000 Naval Logistics Conference*, 14 November 2000, 2.

The MOB provides flight, maintenance, supply, housing, and other forward logistics support operations for U.S. and Allied forces. The MOB can provide 275,000 squared meters of reconfigurable internal stowage and 40,000 cubic meters of fuel stowage.⁵⁵ The decks provide stowage for rolling stock and dry cargo, while liquids are stored in the pontoons and columns. The MOB also has the ability to house an Army heavy brigade of up to 3,000 troops.⁵⁶ As a forward-deployed logistics platform, the MOB would also have the ability to accept personnel and cargo via rotary and fixed wing aircraft and container ships, maintain equipment, and discharge resources to the shore via a variety of surface vessels and aircraft.

The MOB employment follows the building block approach to scalable response. Several operations, including maritime intercept operations (MIO), sanction enforcement, permissive and non-permissive non-combatant evacuation (NEO), and SOF/Strike campaigns, requires the use of one or two 300-meter modules. Decisive expeditionary operations, which require support via C-130 and C-17 aircraft, increase the MOB length requirement to 2,000 meters.

MOB Platform Concepts

There are four platform concepts of the MOB. Four major offshore contractors conceived MOB concepts that help establish feasibility, uncover risks, and support realistic cost estimates. Each of the four concepts employs different methods for connecting modules into a structure of sufficient length to operate conventional take-off and landing aircraft.

⁵⁵ Dr. Robert Zueck P.E., Paul Palo, Gene Remmers, and Robert Taylor, P.E., “Mobile Offshore Base- Research Spin-offs”, *International Offshore and Polar Engineering Conference*, 30 May 1999, 1.

⁵⁶ Ibid.

The McDermott LLC Joint Mobile Offshore Base (JMOB) concept connects semi-submersible platforms to create a runway long enough to land strategic airlift aircraft. McDermott LLC created the compliant hinge semi-submersible concept. Five identical 300-meter steel semi-submersible modules are connected via hinge and ball-joint connectors. The centerline hinge and ball-joint connectors reduces the loads at the expense of increasing relative motion between the modules. The connection also absorbs some of the impact that occurs during the connection process. The hinge and ball-joint connector also gives the JMOB a rapid connect and disconnect ability. McDermott has more than 20 years of design, construction, and operation experience with semi-submersible vessels similar to the JMOB and over 40 years of experience operating offshore construction vessels in the North Sea and off the waters of Australia and Alaska.

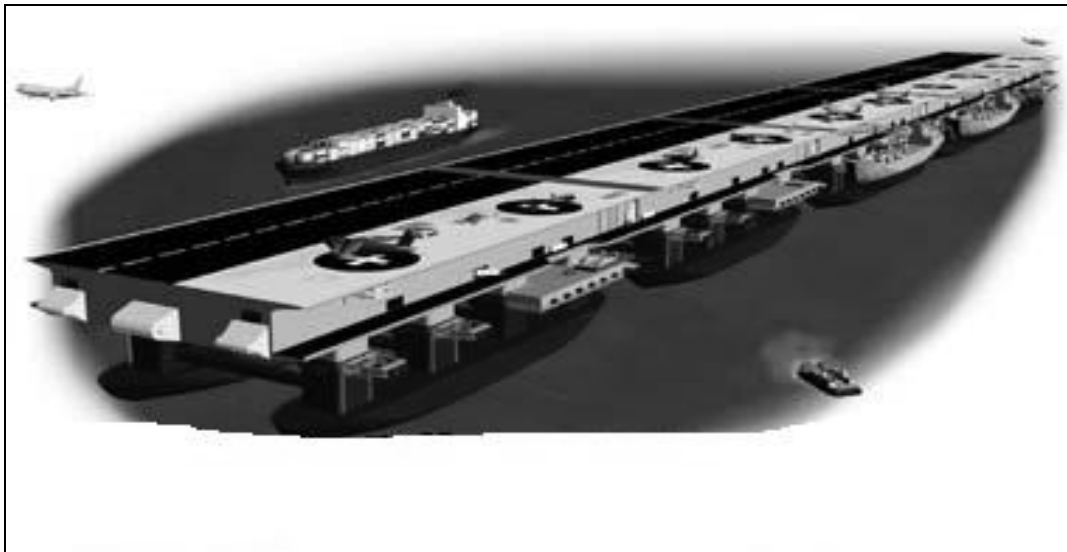


Figure 5. McDermott Inc JMOB

In 1998, The U.S. Defense Department's Office of Naval Research awarded a \$6 million dollar contract to European engineering group Kvaerner ASA for a feasibility study on the proposed mobile offshore base. It was the first time that Kvaerner, the largest commercial ship builder in Europe, had

been designated an approved U.S. government contractor. Kvaerner's concept connects semi-submersible modules using flexible bridges. Two 430-meter damped flexible bridges connect three 220-meter (725 foot) steel semi-submersible modules. The flexible bridges allow the semi-submersible modules to move relative to one another without discrete angular changes in the runway. By allowing the modules to move in relation to one another, the flexible bridges maintain a smooth flight deck with no discrete changes in runway slope. Mr. Per Herbert Kristensen, president of Kvaerner's maritime division, states that once the modules are in position "the structure could be assembled within a day, and when necessary, could be disassembled within 90 minutes."⁵⁷

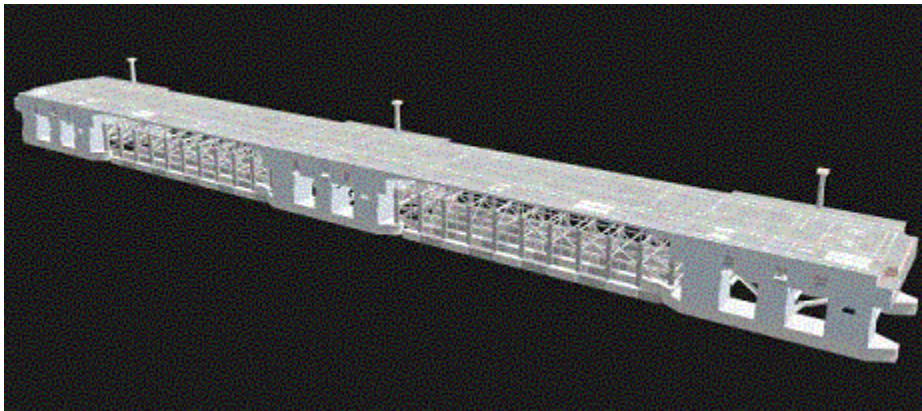


Figure 6. Kvaerner Maritime MOB

Aker Maritime's MOB design concept connects four identical 380-meter (1280 foot) semi-submersible modules via elastomer bearings and post-tensioned cables. Each module has a steel deck, steel cross bracing, and concrete hull. Choosing concrete over steel could result in lower life cycle costs with respect to issues such as fatigue life, blast resistance, and ease of situational construction and repair. The elastomer bearings allow modules to move slightly relative to one another, thus minimizing prohibitive levels of structural stress. Constructed floating on the water, this allows the

⁵⁷ Charles Fleming, "Kvaerner to Study Floating Air Base for U.S. Military," *Wall Street Journal*, January 16 1998, p. 1.

MOB to essentially be constructed to any length and breadth without consideration given to the confining size of a dry docks. A picture of the proposed Aker Maritime MOB is provided below.

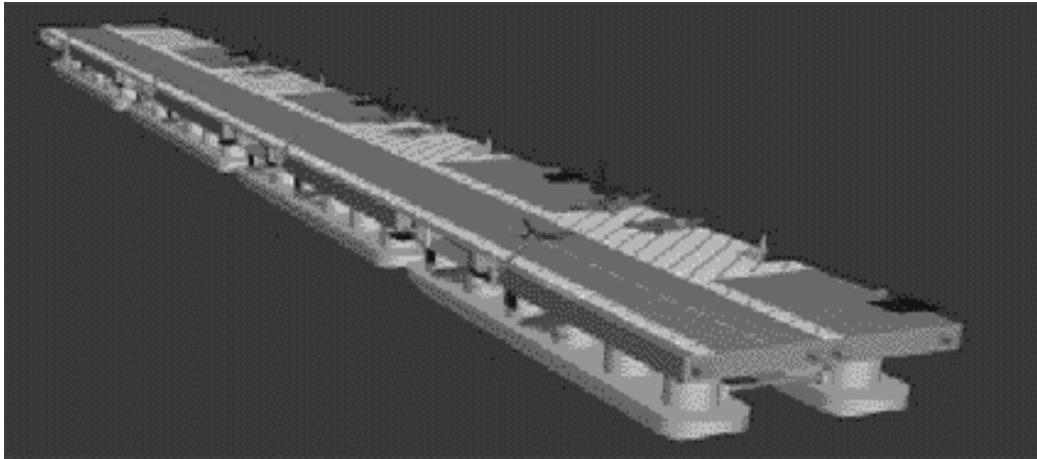


Figure 7. Aker Maritime MOB.

Bechtel National's concept connects independent modules using multi-module dynamic positioning system. Three rectangular semi-submersible steel modules, each about 488m (1600 ft) long, are dynamically positioned relative to one another. The dynamic positioning system is responsible for propelling, assembling, disassembling, and module station keeping. Each module possess up to ten 19,000 kilowatt (25,000 horsepower) dynamically controlled thrusters that maintain the overall orientation and close relation of modules so that the runway remains connect and properly aligned. Control software coordinates the actions of eight thrusters. The control software prevents damage to the module during docking, adapts to mechanical failures on an adjoining module, and counters multi-body string instability due to spatially varying environmental disturbances along the

length of the MOB.⁵⁸ A drawbridge spans the nominal 45m (150 ft) gap between modules and creates a continuous airplane runway. Although the individual modules are functionally connected with the drawbridges, there are no large stress structural connections between modules and no requirement to structurally reinforce the modules to accept large, concentrated connector loads. Each module may operate independently as a mini-MOB whenever fixed-wing air operations are not required. A picture of the proposed Bechtel National MOB is provided below.



Figure 8. Bechtel National Dynamic Positioning MOB.

⁵⁸ *Year 2000 Naval Logistics Conference, 2.*

COMPARATIVE ANALYSIS

This paper uses the tenets of “Seabased Logistics” to compare the capabilities of the MPF(F) and MOB concepts and select the most capable platform for Sea Basing. BLA’s sea basing concept will represent MPF(F) platforms. McDermott’s sea basing concept will represent MOB platforms. Both organizations contributed data to the CNA report, *MAA for MPF Future Sea-Basing Concepts: Volume III, Ship Technical Reviews*.

Primacy of the Sea Base

The foremost potential of Sea Basing is the ability to build, project, and sustain combat power and provide indefinite sustainment from over the horizon. In accordance with the *MNS for MPF(F)*, the sea base will “serve as a conduit for logistics support and sustainment” and will “be able to receive, store, manage, and deploy the equipment and supplies to sustain logistics support of naval operations.”⁵⁹ The “Seabased Logistics” sea base is a floating distribution center and workshop that will provide credible long-term sustainment. Its ability to preposition vital equipment and supplies in the theater, and provide indefinite sustainment to forces ashore will, according to “Seabased Logistics”, reduce or eliminate the logistics footprint ashore.

Sea Basing requires a much greater allocation of available air assets to logistics missions. Sea based aircraft available for logistics support and troop movement include:

- 36 MV-22A Osprey medium-lift tilt-rotor aircraft
- 8 CH-53E Super Stallion heavy-lift helicopters

- 6 UH-1N (4 blade) Huey logistics and medivac helicopters
- 18 AH-1W (4 blade) Cobra attack helicopters

MV-22s and CH-53s will perform the majority of the logistics missions. MV-22s will be used for the transportation of troops, equipment and supplies. The CH-53 specializes in the external lift of heavy vehicles, weapons and oversized equipment. The characteristics of the MV-22 and CH-53 helicopters, taken from the CNA report *MPF 2010 Ship-to-Shore Movement and Sea-based Logistics Support*, are listed in the table below.

Type	Troops	Payload (STON)	Fuel drums
MV-22	24	5.5	3
CH-53	55	16	6

Table 3. MV-22 and CH-53 characteristics

For the purpose of this study, fuel is resupplied by air using 500-gallon collapsible rubber drums. The drums be tied down in a helicopter as internal cargo or slung as an external lift. Using the data from Captain Robert Hagan's thesis, *Modeling Sea-Based Sustainment Of Marine Expeditionary Unit (Special Operations Capable) (MEU(SOC)) Operations Ashore*, one can establish the number of sorties available for the replenishment of ashore forces.

Aircraft	Number of aircraft	Readiness Rate	Sortie Rate	Number of Sorties
MV-22	36	.85	3	91
CH-53	8	.6	2.5	12
Total	44			103

Table 4. MV-22 and CH-53 Sorties.

⁵⁹ United States Navy, *Mission Need Statement (MNS) for Maritime Prepositioning Force for the 21st Century (MPF Future (MPF(F)))*, (Washington, D.C., 2001), 2.

The average availability of the MV-22 and CH-53 includes down time for corrective and preventive maintenance. Sortie rates are based on a 12-hour flight day and includes the time to unload cargo and perform a round trip between the sea base and the destination ashore. The next analysis establishes the daily replenishment requirements for the ashore forces. The Center of Naval Analysis' "MPF(F) Analyses Assumptions and Results" brief details the work between CNA and a group of Marine Corps subject matter experts. Together, they established the composition and sustainment requirements of a Regimental Landing Team (RLT) of 6,000 Marines. The results are listed in the table below.

Unit	Load	Daily Fuel (drums)	Daily ordnance (ST)	Daily stores (ST)
RLT ashore	6,000 troops	121	38	250

Table 5. RLT sustainment requirements

An examination of the data shows that approximately three CH-53 sorties are required to provide the daily ordnance requirement, which leaves nine CH-53 sorties available to transport fuel drums. Forty-five MV-22 sorties are required to provide the daily stores requirement and twenty-two MV-22 sorties can deliver sixty-six fuel drums. This leaves thirty-six MV-22 sorties available for other missions, such as medical evacuation, vertical short take-off and landing support, delivery of maintenance contract teams, and special operations. The MPF(F) sea base contains sufficient organic aircraft to deliver indefinite sustainment from the sea base 25 miles at sea to the force ashore. The MOB, according to McDermott's design concept, will provide a sea base for 150 helicopters and vertical/standing take-off and landing (VSTOL) aircraft and operate conventional take-off and landing (CTOL) cargo aircraft such as the C-17 and C-130. This capability gives the MOB the ability to provide indefinite sustainment to forces ashore as well.

One disadvantage that affects both platform types is the lack of aircraft with the ability to lift and transport loads greater than 16 tons. According to the Defense Science Board's *Task Force on Sea Basing*, many individual items in the inventory of material needed to support a light brigade weigh up to 20 tons (such as standard sea shipping containers and M1A1 tanks). However, the MV-22 can lift 5.5 standard tons and the CH-53 can lift up to 16 standard tons. Heavier loads can only be brought ashore over the beach using LCACs and LCUs, which require extensive mine clearing and removal of anti-ship cruise missile threats. Such operations expose the location of the landing to enemy forces. The need for a new heavy lift aircraft "capable of lifting TEU loads with a theater wide range would make a substantial improvement in the flexibility and efficiency of the seabases."⁶⁰ Capable of lifting more than 20 tons, the new heavy lift aircraft could perform other missions such as ISR, gun ship, troop movement, and transport supplies from the advanced base to the sea base.

Reducing Logistics Demand

In order to provide a reduced logistics demand, the sea base must have the capability to either reduce or eliminate the footprint ashore. According to the "Seabased Logistics" concept paper, placing logistics forces, command and control, and naval fires within the sea base reduces the footprint ashore. Sea based fires reduce the requirement for ordnance and fuel ashore. A sea based logistics force, simplifies support and frees maneuver units from rear area security concerns. Forward arming and refueling points (FARPs) extend air and ground operations without building vulnerable footprints

⁶⁰ Under Secretary of Defense For Acquisition, Technology, and Logistics, *Defense Science Board Task Force on Sea Basing*, (Washington, D.C.: GPO, 2003), 67.

ashore. Reliable air delivery and vast cargo and storage spaces combine to enable the placement of logistics forces on the sea base and reduce the footprint ashore.

As discussed in the previous section, the BLA MPF(F) sea contains enough vertical lift assets to ensure indefinite sustainment of the forces ashore. The CNA stated that the enclosed hull volume of the BLA MPF(F) platforms was grossly sized to “ensure that the 2010 MAGTF lift of vehicles, dry cargo, and cargo fuel could be accommodated by a reasonable number of ships.”⁶¹ Ship designs include a staging area for the joining of troops and vehicles and a marshalling area where combat ready units are collected, organized, and readied for transit to the beach. Five decks are configured to carry MAGTF vehicles and two decks contain a mix of vehicles, dry cargo, and containers. Hoistable ramps permit an uninterrupted flow of vehicles from any hold to the main vehicle deck for access to the stern quarter Ro-Ro ramp. Using data provided in the CNA report, *MAA for MPF Future Sea-Basing Concepts: Volume III Ship Design Technical Reviews*, comparison of the MPF(F) lift capabilities is listed in the table below.

Ship type	ACE Support	Min Air Capable	Fully Air Capable	Provided Lift	Required Lift
Number of ships					
Alt C	1	2	1	N/A	N/A
Alt D	0	2	2	N/A	N/A
Pallets					
Alt C	0	7,680	3,840	11,520	9,529
Alt D	0	7,680	7,680	15,360	14,043
Containers					
Alt C	1,234	1,352	436	3,022	3,183
Alt D	0	1,328	848	2,176	2,300
Vehicles footprint (ft ²)					

⁶¹ Nance, Jr., Souders, and Adams, 25.

Alt C	172,000	258,000/ 246,833	194,333	871,166	860,000
Alt D	0	500,000	360,000	860,000	860,000
Cargo fuel (gal)					
Alt C	1,000,000	3,400,000	1,700,000	6,100,000	6,100,000
Alt D	0	3,050,000	3,050,000	6,100,000	6,100,000

Table 6. MPF(F) Lift Capabilities.

The authors of the CNA report believe that a disadvantage of the BLA MPF(F) platforms was the use of a common hull, which resulted in the sub-optimization of lift capabilities amongst the different ship types. The data shows that the required ship mix resulted in more capability than was required, with the exception of container lift. This is not a great concern because, according to the CNA report, containers will replace the excess pallets without impacting overall storage space on the ships. The report states that there is a cost associated with the amount of wasted space that needed to be addressed in future studies.

According to BWXT Technology, the JMOB will have “3.5 million square feet of climate-controlled storage space to preposition 300 tons of equipment and supplies with 75 million gallons of fuel and 50 million gallons of potable water.”⁶² According to McDermott’s designs, the JMOB will have capacity to hold 3,500 vehicles. A below deck roadway connecting SBUs provide an area for the staging, assembling, and marshalling of troops, equipment, and supplies before they move towards the beach. A SBU will have 175,340 square feet of internal stowage area dedicated to container stowage. The SBU will be able to hold 1,820 8 feet x 8 feet x 20 feet ISO containers. When joined to form a JMOB, the container capacity raises to 9,100 8 feet x 8 feet x 20 feet ISO containers. There is no

⁶² BWXT Technologies, *Joint Mobile Offshore Base*, 20 April 2004 <<http://www.bwxt.com/Products/mob-bwx.html>>, 1.

enclosed space designated for pallet stowage, which requires that pallets be stowed in the same deck space allocated for containers. Using the 0-2 and 0-2.5 levels of the SBU for container stowage, CNA estimates that 4,903 pallets stacked two high could be stored on the 0-3 level of the SBU and a total of 24,515 pallets could be stored on the JMOB. The number of container and pallets that could be stored on the JMOB are in excess of the requirements for CONOPS 'C' and 'D'. Combined with its VSTOL and CTOL airlift capabilities, the JMOB, should it be manufactured to the specified proportions, will provide a greater reduction of the footprint ashore.

In-Stride Sustainment

The core capability that the sea base will provide to achieving in-stride sustainment is selective offload. Selective offload includes techniques such as automated storage and retrieval technologies, package assembly areas, multiple vertical landing spots, capability to support lighterage, and underway replenishment. Selective offload gives the commander easy access to the equipment and supplies necessary to tailor his force to the specific mission. The *MNS for MPF(F)* requires the sea base to have installed a cargo handling and delivery system that will “enable supplies to be transferred, be compatible with Naval and commercial delivery systems, and incorporate the means to deliver this support ashore.”⁶³

The McDermott JMOB design contains three container/heavy lift gantry type cranes to provide Lo-Lo transfer of cargo to and from the SBU. The cranes are located under the 0-4 level and telescope out from the sides of the SBU. Fixed longitudinally, the cranes can move cargo transversely from the centerline of the SBU, outboard about 180 feet over the side of the SBU. The cranes are intended for

the transfer of cargo from commercial Panamax type cargo ships, lighterage, and assault craft. Self-sufficient cargo ships can tie up to the starboard side of the SBU and transfer their loads onto the SBU flight deck. Non-self-sufficient ships, depending on the SBU gantry cranes, will have to constantly reposition in order to align the fixed gantry crane with the next cargo hold or cell to be emptied. There is no mention of automated stowage and retrieval systems or rapid distribution technologies to be employ in the JMOB. CNA believes that the SBU container spaces could be reconfigured to accommodate selective retrieval of all palletized dry cargo in support of the sea basing function.

BLA designed overhead traveling bridge cranes for all Lo-Lo functions on their MPF(F) platforms. The cranes run on a series of longitudinal and transverse tracks mounted on the underside of the flight deck, which is extended forty-feet beyond the maximum beam of the ship on the port side. Twin longitudinal crane rails run the length of the ship along the overhang. A 100 feet x 25 feet side portal opening on the port side provides access for crane transverse transfer rails between the longitudinal flight deck overhang rails and the longitudinal rails running along the interior of the ship. The CNA study reports that the overhead crane system provides efficient cargo transfer from any point on the ship to either the pier or other lighterage along the port side of the ship. The system has some drawbacks. Lo-Lo operations are only available along the port side of the ship. The extensive overhang of the flight deck extension can interfere with pier infrastructure. This becomes more of a problem when the ship enters a shipyard. Another problem can occur during the replenishment of the BLA design ship. When the BLA ship is virtually empty and riding high in the water, the cargo boom or cranes of a self-sustaining commercial dry cargo ship may have trouble placing cargo onto the flight

⁶³ *Mission Need Statement (MNS) for Maritime Prepositioning Force for the 21st Century (MPF Future (MPF(F))), 2-3.*

deck of the BLA ship. The transfer of cargo becomes further complicated by heavy winds and sea states.

For providing rapid and selective retrieval and distribution of supplies, the BLA MPF(F) employs selective access carousels. Cargo carousels are used for the stowage of cargo that must be readily accessible. BLA's carousel system consists of a continuous loop of cargo trays running on a fixed system tracks. Cargo trays accommodate either containers or pallets. The carousel arrangement provides the quick identification and retrieval of any pallet in any container loaded on the tray. Forklift trucks have enough room to maneuver and access containers loaded on the trays.

Adaptive Response & Interoperability

The "Seabased Logistics" concept paper states that the sea base must have an adaptive posture. By maintaining an adaptive posture, the sea base will be able to support a broad range of military operations and changing operational requirements. Should a land base be established for follow-on operations, the sea base will become "a conduit for logistics support and sustainment" originating from CONUS.⁶⁴ Follow-on forces will be able to use the sea base as a intermediate staging platform. The sea base will also be an intermediate staging base for follow-on forces reinforcing the assault echelon. loading and launching of surface crafts, such as advanced amphibious assault vehicles, air cushioned vehicles, and lighters, as well as operate airlift assets. Sea basing platforms will contribute to adaptive response and interoperability through air and surface interface points that will permit the distribution of

⁶⁴ U.S. Navy, *Mission Need Statement (MNS) for Maritime Prepositioning Force for the 21st Century (MPF Future (MPF(F))*, (Washington, D.C: 2001), 2.

equipment and supplies from the sea base to the Amphibious Task Force, other ships, or directly to shore facilities.

The BLA MPF(F) sea base employs several different methods to provide capable interface with various vehicles. As previously mentioned, the BLA MPF(F) sea base maintains enough aircraft to provide sustainment to forces ashore. Traveling bridge cranes provide Lo-Lo cargo transfer between the ship and pier or onto lighterage along the port side of the ship. Also included in the BLA design is a stern quarter ramp that provides Ro-Ro transfer on and off the ship. When used alongside a pier, it permits two-way traffic. The vehicle ramp can also be used for Ro-Ro operations at anchor.

Expeditionary Fighting Vehicles (EFVs) can be launched from the vertical ramp. Vehicles can also be transferred via Ro-Ro discharge facility (RRDF), a floating platform moored to the ships lighterage fitting alongside or streamed astern of the ship. However, CNA reports that this type of transfer “is very sea-state dependent, and transfer of vehicles via the RRDF can be safely undertaken in seas up to about sea state 1 to 2.”⁶⁵ MPF(F) platforms will use an integrated loading platform (ILP) to interface with LCACs. According to BLA’s designs, the ILP will be sized to accommodate the fly-on and landing of LCACs onto its deck. It will also have sufficient clearance to allow maneuvering of the vehicles, container handlers, or forklift trucks from the ship onto the LCAC.

McDermott’s JMOB will rely on its aircraft to provided adaptive response and interoperability. Because of it is too large to enter a port for cargo delivery, all JMOB Lo-Lo and Ro-Ro operations will have to be conducted at sea. Three container/heavy lift gantry cranes as mentioned before perform Lo-Lo transfer of cargo. The ambiguous details about the JMOB’s Ro-Ro capabilities impede its ability to contribute to adaptive response and interoperability. Ro-Ro operations are conducted via an inclined

ramp. According to McDermott's plans, the incline ramp runs along the port side of the SBU and onto a moveable landing platform. The landing platform will perform LCAC interface and also allow lighterage to moor and transfer vehicles to and from the SBU. Similar to the MPF(F) sea base platforms, JMOB Ro-Ro operations will be sea state dependent.

Force Closure and Reconstitution at Sea

Force closure is "the at sea arrival, assembly and integration of operational forces to realize their combat power and coordinate associated logistics sustainment."⁶⁶ In accordance with the "Seabased Logistics" concept paper, the sea base will allow ashore forces to rapidly reconstitute at sea for redeployment. The *MNS for MPF(F)* requires sea basing platforms to be capable of in-theater, at sea, reconstitution. Sealift and airlift provides a rapid deployment of heavy CONUS based MAGTF. RSOI operations are performed on the sea base enroute to the AOA. Large staging and assembly areas allow troops to marry-up with their vehicles, equipment, and supplies and form into combat ready units. Staging areas also provide easy access to equipment for inspection, testing, and maintenance. Adequate berthing is required for the embarkation of troops. CNA's staging requirements for sea basing platforms are 7,000 squared feet on each ship and 50,000 squared feet in the squadron. Sea basing platforms enable force closure and reconstitution by providing housing, staging, and maintenance shops.

BLA MPF(F) ships provide adequate berthing and staging and assembly areas. The ship mix for CONOPS 'C' and 'D' provide 320,810 and 400,060 squared feet for the housing of personnel.

⁶⁵ Nance, Jr., Souders, and Adams, 68.

⁶⁶ *Seabased Logistics*, XI-9.

Both totals exceed the area required by the CNA report. The 'B' deck is the main vehicle deck for all three ship types. The space is a combination vehicle stowage area and staging and assembly area. The staging area includes a vehicle maintenance shop and maintenance bay. Based on BLA's drawings, each ship type has 30,000 squared feet of staging and assembly area, which exceeds CNA's requirements. The vehicle maintenance shops are located in the staging and assemble area on B deck. The vehicle maintenance bay takes up close to half of the staging and assembly area. Because the maintenance shop and bay share the space of the staging and assembly areas, they are considerably smaller than CNA's required 10,000 and 30,000 squared feet. BLA's designs satisfied the CNA's required personnel accommodation area. ACE Support Ships holds 402 MAGTF personnel, Minimally Air-Capable Ships accommodate up to 5,018 personnel, and each Fully Air-Capable Ships holds up to 3,200 personnel. The largest disadvantage of using MPF(F) for force closure is the inability for troops to be flown directly onboard the sea base. The disadvantage that MPF(F) sea base is its inability to perform at-sea reception of forces, which requires the use of strategic airlift. MPF(F) sea base ships cannot receive strategic transport aircraft, such as C-17 Globemaster and C-130 Hercules. Without this ability, Marine must fly to a ISEP, where they embark the MPF(F) sea base and marry-up with equipment enroute to the AOA. This does not meet the 'at-sea arrival' requirement of the *MNS for MPF(F)* and "Seabased Logistics".

McDermott's JMOB ability to operate strategic airlift is its greatest advantage over MPF(F) platforms. Five independent semi-submersible single base units (SBUs) join together to provide 5,000 foot landing platform for operation of C-130 and C-17 strategic lift aircraft. RSOI of operational forces can be accomplished at sea, enroute to the AOA without relying on host nation supported ISEPs. Once in theater, the JMOB would continue to operate independent of any shore-based host nation support.

The JMOB provides extra space for troops marry-up with their vehicles, equipment, and supplies.

According to McDermott's designs, the SBU dedicates 49,192 square feet to staging and the JMOB has a total of 245,960 square feet dedicated to staging, which exceeds the 50,000 squared feet require by CNA's study. Surprisingly, one of the JMOB's disadvantages is within its troop accommodations. CNA's study reports that JMOB can only accommodate 7,500 troops.

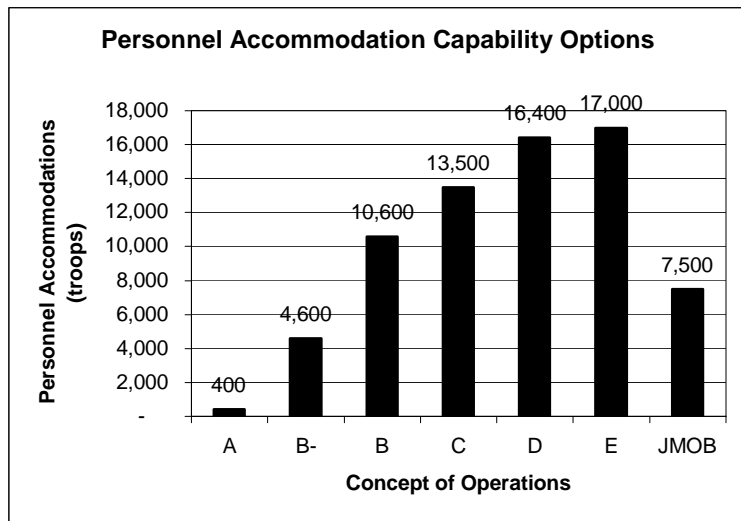


Figure __. Personnel accommodations for different CONOPS.

When compared to the sea base platforms in the other CONOPS, the JMOB holds less troops than the MPF(F) sea base sustaining the ashore force in CONOPS 'B'.

OTHER CONSIDERATIONS

Mobility

The MPF(F) ship will have engineering plants similar to the USNS BOB HOPE Class of LMSR ships. These engineering plants contain either gas turbine or diesel propulsion systems that can maintain transit at speeds up to 24 knots. Gas turbine and diesel propulsion plants are able to come up to speed quickly and provide the ships with advanced maneuverability. MPF(F) sea base platforms will have the ability to keep station with the Expeditionary Strike Group (ESF). The increased speed also helps the MPF(F) sea base maneuver in coordination with the assault force.

According to McDermott designs, the SBU reaches transit speeds of 15 knots when operating in the deballasted-up mode. At fifteen knots, the MOB would have to travel in front of the ESF in order to arrive on station on time. However, CNA's analysis states, "In a real sea state 4 condition, a transit speed over the ground in the 7 to 10 knots is about the best that can be expected with the SBU."⁶⁷ There are no rudders on the McDermott design, which requires propeller thrust to be used to counteract the actions of the wind and waves. Because main propulsion must counteract the translational effects of wind and waves on the SBU, less propeller thrust is available to move the SBU forward through the water. Once joined with other SBUs, the JMOB becomes even less maneuverable. In his article "Setting the Record Straight on Mobile Offshore Bases," Commander Paul Nagy states,

⁶⁷ Nance, Jr., Souders, and Adams, 131.

“MOBs are slow, capable of only 4 to 5 knots when fully assembled.”⁶⁸ A slow, fairly non-maneuverable MOB would become an accessible target to long range anti-ship cruise missiles.

Force Protection/Vulnerability

A sea base would be a prime target for anti-ship cruise missiles and tactical ballistic missiles, or even air attack. The ships of the MPF(F) would be embedded within the ESF and would depend on those ships to provide protection from enemy threats. Also, being dispersed amongst the ESF, the MPF(F) ships do not present enemy forces with a single target of opportunity. The MOB presents the adversary with a large, slightly mobile target for cruise missile attack. Although the platform is virtually unsinkable, a determined attack could lead to enough damage as to cause the MOB to be inoperable for long periods of time. Either effective self-defense systems would have to be installed onto the platform, raising the cost significantly, or large portions of the ESF would have to be devoted to protecting the MOB. The MOB could also move beyond cruise missile range, but the increased distance between the MOB and the coastline reduces the effectiveness of equipment transfer by either seaborne assets (LCACs, EFVs, and LCUs) or vertical lift assets (MV-22 and CH-53).

Cost and Constructability

Cost is always one of the first issues mentioned when comparing the MPF(F) to the MOB. The Navy’s largest noncombatant ships, USNS BOB HOPE Class LMSR (Large, Medium Speed, Roll-On/Roll-Off, ship) cost \$265 million. Using this class of ship as an example for the NAVSEA/AME and BLA monohull sea base ships, one can see that cost of individual MPF(F) ships could easily

⁶⁸ CDR. Paul Nagy, USN, “Setting the Record Straight on Mobile Offshore Bases,” *National Defense*, August 2001, 62.

exceed \$300 million per ship. A sea base made up of a squadron of NAVSEA/AME designed MPF(F) ships could cost \$1.8 to \$2.4 billion. A sea base made up of a squadron of BLA designed MPF(F) ships could cost \$1.2 billion. The single module MOB is estimated to cost \$1.5 billion and a CTOL capable MOB will cost \$5 to \$8 billion.

An accurate cost of the MOB is difficult to project for several reasons. First, the operational requirements for the MOB are not yet refined. These requirements include specific platform length and width. Second, the trade-off between acquisition versus life cycle costs has not been decided. Lastly, the number of units to be built is also unknown. Initial estimates by the four concept designers are that a single module will cost approximately \$1.5 billion and a full CTOL capable MOB would cost between \$5 and \$8 billion. The single module MOB cost is comparable to the MPF(F) sea base platforms, but both the NAVSEA/AME and BLA MPF(F) squadron cost less than the CTOL capable MOB.

MOB constructability is questionable. Platforms the size of the MOB have never been constructed. At approximately 300,000 metric tons of displacement, the smallest proposed MOB semi-submersible module is larger than any existing semi-submersible hull. The Gorilla V drilling platform, the largest drilling platform in existence, is “one-half to two-thirds the size of a single module and is of the jack-up design, not a semisubmersible.”⁶⁹ In the article “Mobile Offshore Base – A Self Propelled Logistics Platform,” authors Dr . Robert Zueck and Robert Taylor state that construction of the MOB is within the capabilities of the nation’s shipyards. A risk-based study performed in 1999 shows that

⁶⁹ Naval Studies Board and National Research Council, *Technology for the United States Navy and Marine Corps 2000-2035: Becoming a 21st Century Force. Volume 8 Logistics*, (Washington, D.C: National Academy Press, 1997), 23.

MOB modules can be built in the U.S. using a combination of onshore and offshore facilities.⁷⁰

However, the CNA report *MAA for MPF Future Sea-Basing Concepts: Volume III* disagrees with their findings.

According to McDermott's schedule, one SBU will take 33 months to complete and a finished JMOB will take over 13 years to complete. CNA estimates that one SBU is composed of approximately 148,500 short tons of steel and the JMOB would require 742,500 short tons of steel. The lower hulls and upper hulls would have to be manufactured in separate yards and brought together at some sight with adequate water depths and facilities to join all to the pieces. To meet McDermott's timeline, CNA estimates that the yard building the upper hull "would have to process over 2,100 tons of steel per week."⁷¹ This rate of product exceeds the current capabilities of the shipyards proposed for building the upper hull of the SBU.

CONCLUSION

The Defense Science Board's *Task Force on Sea Basing* states, "Dollar for dollar, a modern MPF(F) design would provide the operational commander greater freedom of movement and choices for operational employment."⁷² I have to agree with their assessment. MPF(F) concept is the best platform for Sea Basing. MPF(F) sea base enables the tenets of "Seabased Logistics" by protecting

⁷⁰ Robert L. Taylor and Dr. Robert F. Zueck are referring to W. Bender, B Ayyub, and Blair, "Assessment of the Constuction Feasibility of the Mobile Offshore Base," *Int Workshop on Very Large Structures(VLFS-99)*, University of Hawaii at Manoa, Honolulu, HI, September 1999, Vol II, 699-707.

⁷¹ Nance, Jr., Souders, and Adams, 144.

⁷² Under Secretary of Defense For Acquisition, Technology, and Logistics, *Defense Science Board Task Force on Sea Basing*, (Washington, D.C.: GPO, 2003), 73-74.

the primacy of the sea base, reducing the footprint ashore, employing selective offload of equipment and supplies, and providing adaptive response and interoperability with other vessels and transport vehicles. Today's LMSR ships are perfect models for the development of monohull logistics ships. BLA and NAVSEA/AME designs give the Navy a scalable prepositioning and sustainment sea base that can respond to many different contingencies. MPF(F) ships maintain the primacy of the sea base by employing its vertical lift assets to indefinite sustainment of assault forces, while remaining over-the-horizon. It provides sufficient stowage to maintain logistics afloat and reduce the footprint ashore. The ability of the MPF(F) sea base platforms to interface with commercial cargo ships, logistics shuttle ships, vehicles, and LCACs makes the sea base a conduit of logistics, as required by the *MNS for MPF(F)*. Selective offload is designed into the MPF(F) platforms by employing selective access carousels. The MPF(F) enables force closure and reconstitution at sea by maintaining adequate berthing, maintenance, and staging areas. Its speed allows it to transit with the ESF and also allows for the rapid repositioning of the sea base in. The MPF(F) ships are also within the capability of today's shipyards. On the negative side, the MPF(F) sea base cannot receive forces enroute to the AOA via strategic airlift. MPF(F) ships will require host nation supported ISEP for the embarkation of Marines. Sea basing developer must also ensure that the design of MPF(F) ships have at-sea handling characteristics that withstand sea-state 4. This includes at-sea cargo transfer to and from lighters alongside and from black hull commercial vessels to sea base ships.

The MOB's most valuable contribution to sea basing is its ability to operate strategic airlift. At sea arrival, assembly, and integration of operational forces completely reduces the need for host nation supported airfields and sea ports. The MOB's large structure allows for the operation and maintenance of more aircraft and stowage of cargo than the MPF(F) ships. Surprisingly, the MOB carried less

troops that most of the MPF(F) squadron mixes, which impacts the power projection of the ESF.

Although published reports state that the MOB can transit at speeds up to 15 knots, further study showed that the MOB's top transit speed is less than 10 knots. Cost, constructability, and vulnerability of the CTOL capable MOB make this option of sea basing unfeasible. Once in theater, the ESF has to dedicate considerable resources towards the protection of the MOB. However, the use of a 300-meter SBU is technically feasible. American shipyards have the ability to manufacture the basic SBU. The cost of the individual MOB module is comparable to a squadron of MPF(F) ships and it would house more troops, vehicles, and rotary wing aircraft than the MPF(F) ships. Its low speeds and lack of maneuverability limits its operation with certain aircraft and creates a defensive liability to the ESF.

Both sea basing platforms require a vertical lift aircraft that can transport loads of 20 tons or greater. The MV-22 is projected to carry 5 tons, while the CH-53 can carry up to 16 tons. Without an aircraft with this capability, tanks and ISO containers can only be delivered by LCACs and LCUs. Mine detection and clearing is a time-sensitive and overt process that gives enemy forces time to reinforce the suspected landing site. Heavy lift vertical aircraft will enable the landing force to exploit the advantages of *OMFTS* and *STOM*.

BIBLIOGRAPHY

- Ballantine, Duncan S. *U.S. Naval Logistics in the Second World War*. Princeton: Princeton University Press, 1947.
- Brackens, Paul. *Fire in the East: The Rise of Asian Military Power and the Second Nuclear Age*. New York: HarperCollins Publishers, 1999.
- BWXT Technologies, Inc. *Joint Mobile Offshore Base*. 20 April 2004 <<http://www.bwxt.com/Products/mob-bwx.html>>.
- Cagle, Malcolm W., CDR, USN, and CDR Frank A. Manson, USN. *The Sea War in Korea*. Annapolis: United States Naval Institute, 1957.
- Carter, Worrall R. Rear Admiral, USN. *Beans, Bullets, and Black Oil*. Washington: Department of the Navy, 1953.
- Clark, Vern, Admiral, USN. "Sea Power 21: Projecting Decisive Joint Capabilities," *Proceedings*, October 2002, 32-37.
- Congress. Senate. Armed Services Committee. Seapower Subcommittee. *Hearing on FY2003 Budget for Navy Equipment on FY2003 Budget for Navy Equipment*, 9 April 2003.
- Congress. Senate. Armed Services Committee. *Defense Strategy Review*, June 21, 2001.
- Curatola, John M. and Robert Bovey Jr. "The Future Maritime Prepositioning Force," *Proceedings*, November 2001, 87-89.
- Deal, Kim and Yana Ginburg. *Operations From the Sea Base Wargame: Preliminary Follow-On Report*. Alexandria: Center for Naval Analyses, 2003.
- Department of Defense. *Annual Report to the President and the Congress*. Washington, D.C.: U.S. Government Printing Office, 2002.

- Defense Science Board. Under Secretary of Defense For Acquisition, Technology, and Logistics. *Task Force on Sea Basing*. Washington, D.C.: GPO, 2003.
- Eccles, Henry E. *Operational Naval Logistics*. NAVPERS 10869: Bureau of Naval Personnel, 1950.
- Fleming, Charles. "Kvaerner to Study Floating Air Base for U.S. Military." *The Wall Street Journal*, January 16 1998, p. 1.
- Gordon England, Admiral Vern Clark, and General James L. Jones, *Naval Power 21...A Naval Vision*, October 2002, 5.
- Field, Jr., James A. *History of United States Naval Operations: Korea*. Washington, D.C.: U.S. Government Printing Office, 1962.
- Hagee, Michael, General, USMC, "Toward a New Concept of Seabasing," United States Naval Academy, 4 March 2003.
- Hagan, Robert M., CAPT, USMC. *Modeling Sea-Based Sustainment Of Marine Expeditionary Unit (Special Operations Capable) (MEU(SOC)) Operations Ashore*. Master's Thesis, Naval Postgraduate School, 1998.
- Henrix II, Henry J., LCDR, USN, "Exploit Sea Basing," *Proceedings*, August 2003, 61-63.
- Hooper, Edwin B. *Mobility, Support, Endurance: A Story of Naval Operational Logistics in the Vietnam War 1965-1968*. Washington: Naval History Division, Department of the Navy, 1972
- Matthews, James K. and Cora J. Holt. *So Many, So Much, So Far, So Fast: United States Transportation Command and Strategic Deployment for Operation Desert Shield/Desert Storm*. Washington, D.C.: Joint History Office, Office of the Chairman of the Joint Chiefs of Staff and Research Center, U.S. Transportation Command, 1996.
- Marolda, Edward J. *By Sea, Air, and Land: An Illustrated History of the U.S. Navy and the War in Southeast Asia*. Washington: Naval Historical Center, Department of the Navy, 1994.
- McAllister, Keith R. *MPF 2010 Ship-to-Shore Movement and Sea-based Logistics Support, Volume I: Report*. Alexandria: Center for Naval Analyses, 1998.
- Moore Jr., Charles W., Vice Admiral, USN, and Hanlon Jr., Lieutenant General Edward. "Sea Basing: Operational Independence for a New Century," *Proceedings*, January 2003, 80-85.
- Nagy, Paul, Commander, USN. "Setting the Record Straight on Mobile Offshore Bases." *National Defense*, August 2001, 62.

- Nance, Jr., John F., Robert M. Souders, and Douglas A. Adams. "MAA for MPF Future Sea-Basing Concepts: Volume III Ship Design Technical Reviews." Alexandria: Center for Naval Analyses, 1998.
- Nance, Jr., John F., Vito R. Milano, Robert M. Souders, and Thomas A. Bowditch, *MAA for MPF Future Sea-Basing Concepts: Phase I Summary Report*. Alexandria: Center for Naval Analysis, 1997.
- Natter, Robert J., Admiral, USN, "Access Is Not Assured" *Proceeding*, January 2003, 39-41.
- Naval Studies Board and National Research Council. *Technology for the United States Navy and Marine Corps 2000-2035: Becoming a 21st Century Force. Volume 8 Logistics*. Washington, D.C: National Academy Press, 1997.
- Naval Studies Board and National Research Council. *Naval Expeditionary Logistics: Enabling Operational Maneuver From the Sea*. Washington, D.C: National Academy Press, 1999.
- Shlapak, David A., John Stillion, Olga Olikier, and Tanya Charlick-Paley. *A Global Strategy for the U.S. Air Force*. Arlington: RAND, 2002.
- Siegel, Adam B. "Base Access Constraints and Crisis Response." *AIRPOWER Journal*, Spring 1996.
- Siegel, Adam B. "Scuds Against Al Jubayl?," *Proceedings*, December 2002, 2-6.
- Souders, Robert M. "Mission Area Analysis for MPF Future/Sea Basing Concepts Final Briefing." Alexandria: Center for Naval Analyses, 1998.
- Souders, Robert M., Bryan Tomer, and Dr. Wendy Trickey. "MPF(F) Analyses Assumptions and Results: Briefing for the Seabasing Conference." Alexandria: Center for Naval Analysis, 2002.
- Thompson, Julian. *Lifeblood of War: Logistics in Armed Conflict*. London: Brassey's, 1991.
- United States Marine Corps Combat Development Command. *Maritime Prepositioning Force 2010 and Beyond*. Quantico, VA: Concepts Division, Marine Corps Combat Development Command, 1997.
- United States Marine Corps Combat Development Command. *Seabased Logistics*. Quantico, VA: Concepts Division, Marine Corps Combat Development Command, 1988.
- United States Navy and United States Marine Corps. *Naval Doctrine Publication 4: Naval Logistics*. Washington, D.C., 1995.

United States Navy and United States Marine Corps. *Naval Doctrine Publication 4: Naval Logistics*. Washington, D.C., 2001.

United States Navy. *Mission Need Statement (MNS) for Maritime Prepositioning Force for the 21st Century (MPF Future(MPF(F))*. Washington, D.C., 2001.

United States Navy. *Naval Transformational Roadmap: Power and Access ... From the Sea*. Washington, D.C., 2002.

United States Navy and U.S. Marine Corps. *Naval Operating Concept for Joint Operations*. Washington, D.C., 2003.

Webb, Katherine Watkins. "Are Overseas Bases Worth the Bucks? An Approach to Assessing Operational Value and an Application to the Philippines." Ph.D. diss., RAND Graduate Institute, 1988.

Zueck, Robert F., Dr., P.E. and Robert Taylor, P.E. "Mobile Offshore Base, Logistics Platform for the 21st Century" *Year 2000 Naval Logistics Conference*. 14 November 2000.

Zueck, Robert F., Dr., P.E., Paul Palo, Gene Remmers, and Robert Taylor, P.E. "Mobile Offshore Base- Research Spin-offs", *International Offshore and Polar Engineering Conference*. 30 May 1999.